INDEXED.

Marine Engineering

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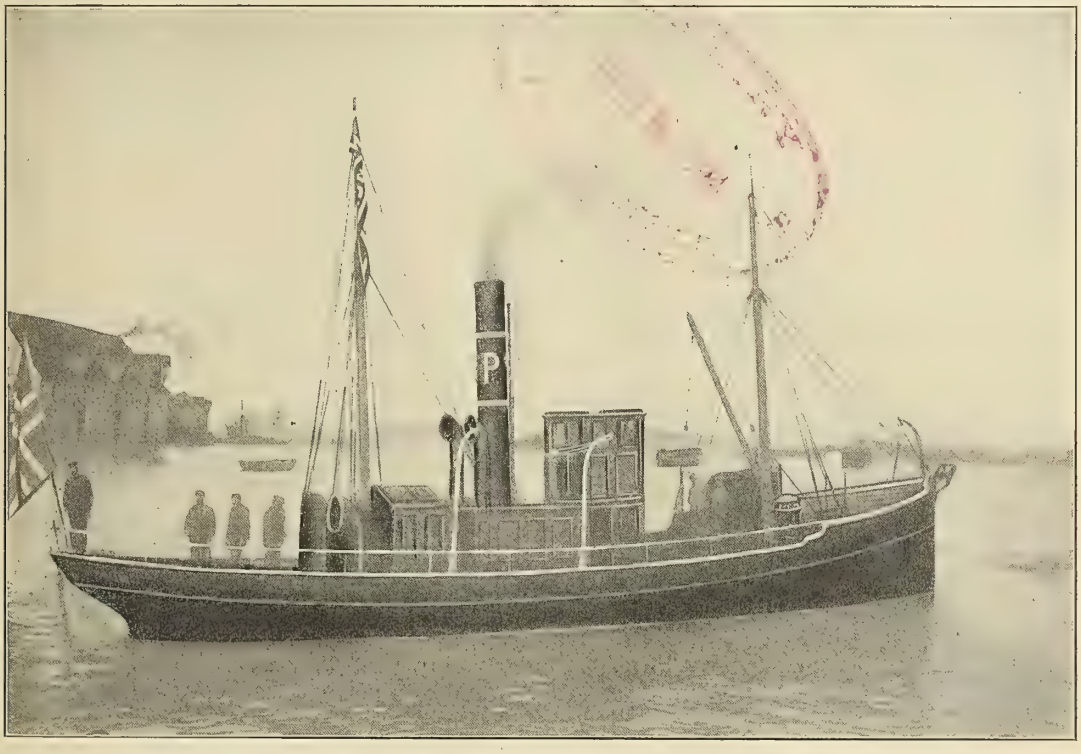
NORWEGIAN FISHING STEAMER.

The following description and illustrations show the latest type of the smaller 75-foot Norwegian fishing steamers, as used on the western and northern coast of Norway for fishing in home waters. Boats of this class are built very heavy and strong to stand the heavy weather encountered in the northern seas. From October to February they are fitted out with nets for herring fishing, and the rest of the year for line fishing after halibut, codfish, and haddock.



NORWEGIAN FISHING SCHOONER MJOLNER; USED ON THE NORTH SEA.

The principal dimensions of hull and machinery are given on the data card, while the half-tone and drawings show the construction and arrangement of the hull and machinery. They are single flush-decked vessels, and are classed A1 under Det Norske Veritas, built of steel throughout. The two pole masts are fitted with leg-of-mutton sails, foresail, mainsail, and jib, and the foremast has one derrick for handling cargo.

The bar keel is 4 3-4 by 7-8 inches, the frames 2 1-2 by 2 by 4-20-inch angles spaced 19 inches. The reverse frames are 2 by 2 by 4-20 inches. The stem and stern post of forged steel. Rudder head 2 7-8 inches diameter. At the bow on the water line the framing is strengthened about 20 feet aft with shorter frames worked in between the others according to the rules for ice protection. The shell plates are also 1-16 inch thicker on this part.

Besides the forward and aft collision bulkheads there are three water-tight bulkheads of 1-4-inch steel plates extending to deck. Bunkers with the capacity of 14 tons of coal extend athwartship forward boiler, and with two wing bunkers on each side of boiler carried so far aft as possible.

The plating is laid in inside and outside strakes as shown. The bulwarks are carried 20 inches above deck, increasing to 36 inches at forward end, and are topped by special heavy rail iron 4 by 2 by 3-8 inches. A 2-inch half-round iron is carried all around the vessel at the deck line. On the starboard side are two similar irons at water line and below, to act as fender and leads for fishing lines. At the bow are similar fenders on both sides for anchor chains.

The deck is laid with Norway pine 2 1-2 by 4 inches, and is fitted with four pairs of bitts, chocks, and cleats.

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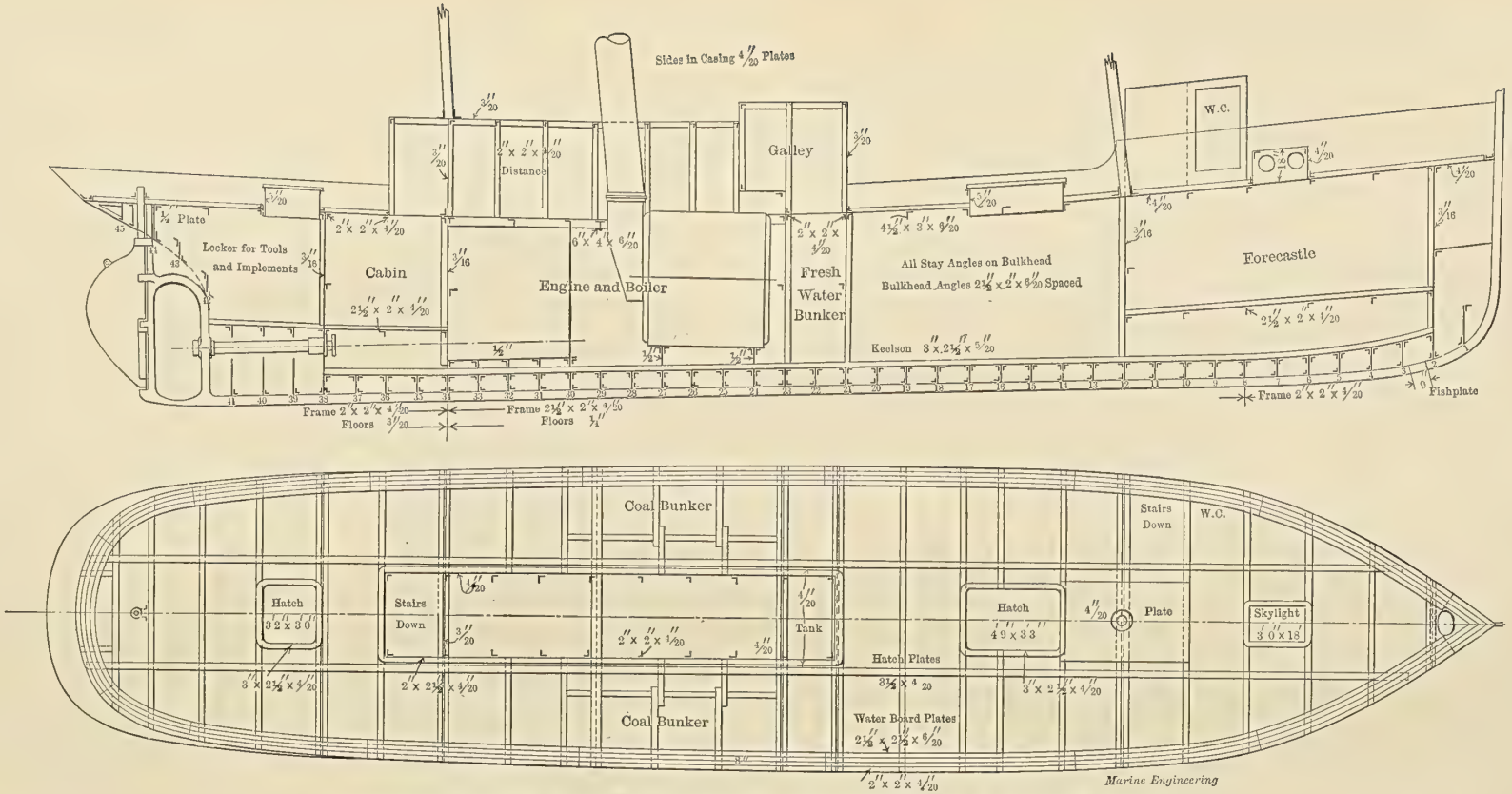


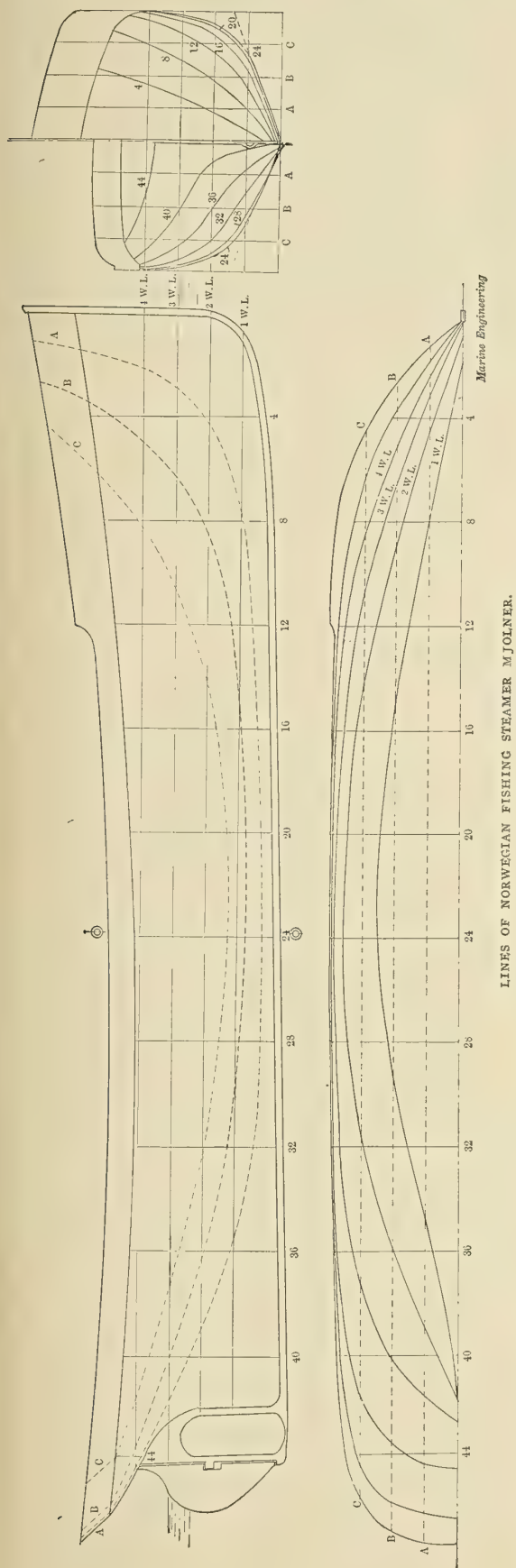
LONGITUDINAL AND DECK PLANS OF A NORWEGIAN FISHING STEAMER, BUILT AT STAVANGER, NORWAY.

Forward the foremast is a vertical steam-driven capstan, which is used both for hoisting the anchors and hauling the cable for the fishing nets. The anchors are 350 pounds, without stocks, of the common old-style, as these are considered the safest by the fishermen. At the bow there is one anchor davit and a set of rollers of novel design over which the fishing cable is hauled in. On starboard side is another set of rollers for ordinary fishing lines.

Over the engine and boiler room is built a steel casing 4 feet wide, carried 5 feet above the deck, with engine skylights and entrance doors on each side. At forward end of this is the galley, and above this the wooden pilot house, 5 feet 9 inches long, 4 feet wide, and 6 feet 2 inches high. In the pilot house are the hand-steering gear, spirit compass, engine telegraph, and a patent chart case which in a convenient manner keeps the charts free from wear and tear. Aft of the casing is the entrance to the cabin and the lantern locker. In the deck house forward on port side is the entrance to the forecastle and the water closet.

The crew's quarters are 16 feet long, and here are berthed eight fishermen, one fireman, and one cook. It is pretty well ventilated and lighted, but rather small. In the cabin aft are accommodations for the captain and the engineer. The fittings are plain but neat, and as comfortable as the place allotted will allow. Over the gutters are laid grating of 3-4 by 5-16-inch convex irons, with 1-2-inch space, so no fish (especially herring) can fall down in the gutter and go overboard through the scupper holes.

One 16-foot dinghy is carried, and six dories are stowed on deck when the boats are employed in cod, halibut, and haddock fishing. There are three boat davits, two starboard and one port. There are also hoisting tackle from the masts for taking in the dories. Aft of the cabin is a store room for fishing nets and lines. The main hold is carefully isolated on the bulkheads and ceiled with 2-inch planks, calked with one



LINES OF NORWEGIAN FISHING STEAMER MJOLNER.

thread of oakum, and pitched. Here are built up with loose boards the bins, for fish and ice. The capacity of this hold, of iced fish, is about 20 tons.

A fresh-water tank of about 350 gallons capacity is placed right below the galley under deck in the cross bunker. The fresh-water pump is in the galley.

MACHINERY.

The propelling power of this vessel consists of a vertical, direct-acting, compound engine, data of which is given on the card. Marshall's valve gear works the valves; all pumps are worked from the low-pressure engine crosshead. All links and eccentrics, and arms for the valve gear, are of cast steel. Main bearings are babbitted.

All exhaust steam from auxiliaries is trapped to avoid waste of fresh water. The donkey pump is of the Worthington duplex pattern, cylinders 3 by 2 by 3 inches. It is used for feeding the boiler either from hot well, from condensed water tank, or from the sea cock. It also circulates the water in the boiler during earlier period of firing; it gives water to deck and fire hose and acts as a ballast pump. Besides the water fire hose there is arranged a steam fire hose which takes steam from the capstan steam pipe on deck.

The boiler is a horizontal, single-end Scotch boiler of sufficient capacity for easy steaming. Of interest may be noted that the boiler shell is of *solid rolled* steel

NAME—Mjölner. **NATIONALITY**—Norwegian. **TYPE**—Fishing steamer.
LAUNCHED—1903. **BUILDER**—Rosenbergs Mekaniske Verksted, Stavanger, Norway.

Length over all	75 ft. 0 ins.	**Engine**	compound
" over stem and stern	70 " 0 "	Cylinder diameter	8 ins. and 17 1-2 ins.
Beam molded at deck	15 " 9 1-2 "	Stroke	12 ins.
" " " W. L.	15 " 6 "	R. P. M.	155
Depth, top keel, top beam	8 " 9 "	I. H. P., estimated	80
Draft, aft	7 " 6 "	Speed	9 knots
" forward	5 " 9 "	Condenser surface	115 sq. ft.
Displacement	82 tons	**Boiler**	S. E.
Area of midship section	64.6 sq. ft.	Diameter	7 ft. 0 ins.
Block coeff	0.446	Length	6 " 6 "
Coal bunker capacity	14 tons	Furnace	33 "
Propeller	Friedenthal's corrugated	Pressure	140 lbs.
Diameter	4 ft. 6 ins.	H. S.	345 sq. ft.
Pitch	6 " 9 "	G. S.	12 " "
Number of blades	4	Draft	natural
Area of blades	11 sq. ft.	Coal consumption per I. H. P.	1.75 lbs.
Material	cast iron		

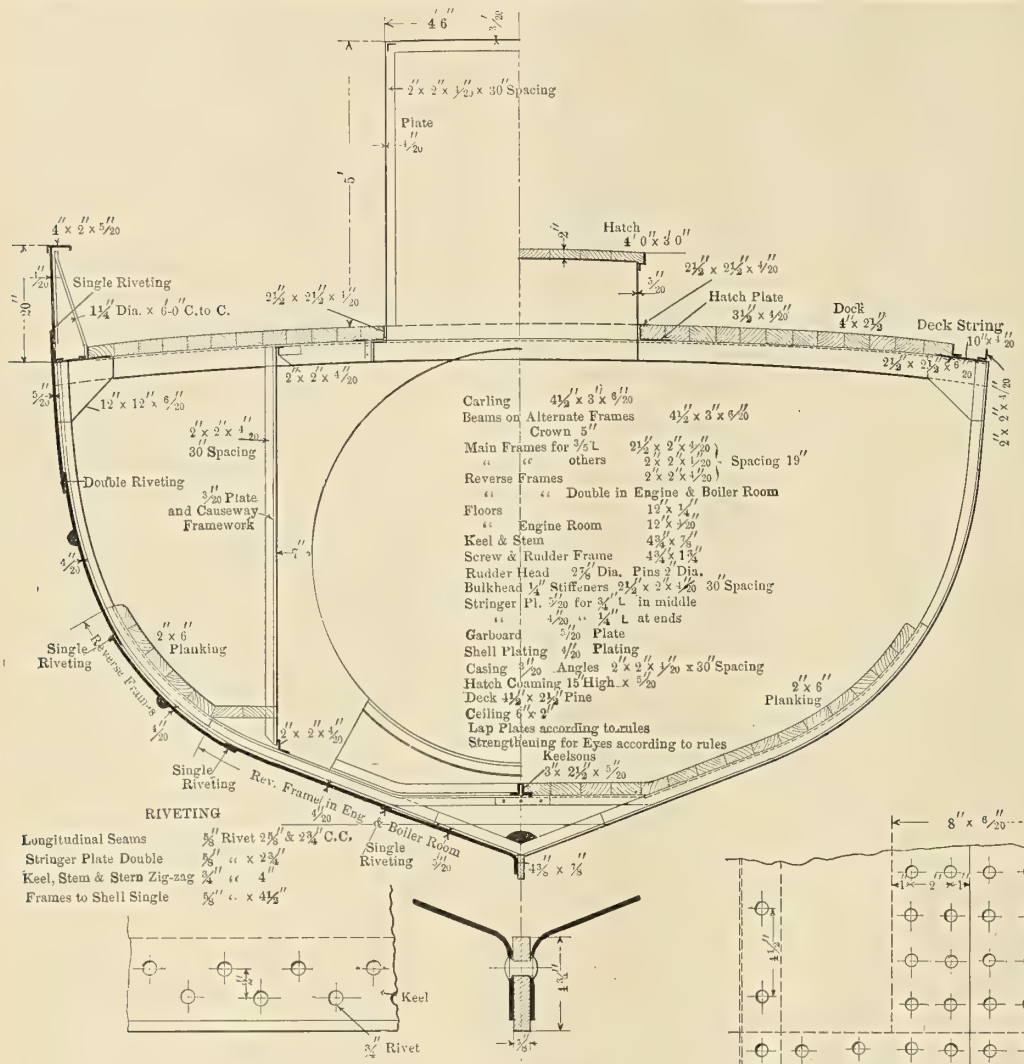
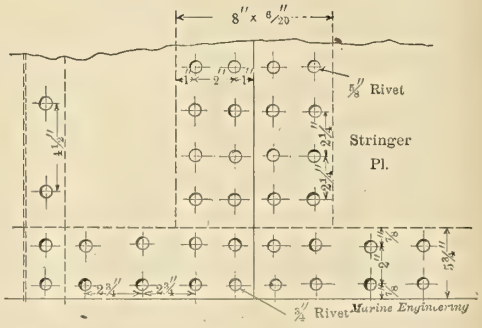


Plate 1/20
2" x 2" x 1/20 x 30" Spacing
Hatch 4'0" x 3'0"
Hatch Plate 3 1/2" x 1/20
Deck 4" x 2 1/2"
Deck String 10" x 1/20
Single Riveting
1 1/4" Dia. x 6-0" C. to C.
2 1/2" x 2 1/2" x 1/20
2" x 2" x 4/20
12" x 12" x 6/20
2" x 2" x 1/20
30" Spacing
Double Riveting
3/20 Plate and Causeway Framework
2" x 6" Planking
Single Riveting
Rev. Frames
1/20
2" x 2" x 1/20
Single Riveting
Rev. Frames in Eng. & Boiler Room
Single Riveting
3/20
4 7/8" x 1/8"
Carling 4 1/2" x 3" x 6/20
Beams on Alternate Frames 4 1/2" x 3" x 6/20
Crown 5"
Main Frames for 3/5 L 2 1/2" x 2" x 1/20
" " others 2" x 2" x 1/20 Spacing 19"
Reverse Frames 2" x 2" x 1/20
" " Double in Engine & Boiler Room
Floors 12" x 1/4"
" Engine Room 12" x 1/20
Keel & Stem 4 3/4" x 7/8"
Screw & Rudder Frame 4 3/4" x 1 3/4"
Rudder Head 2 7/8" Dia. Pins 2" Dia.
Bulkhead 1/4" Stiffeners 2 1/2" x 2" x 1/20 30" Spacing
Stringer Pl. 7/20 for 3/4" L in middle
" 4/20 " 1/4" L at ends
Garboard 5/20 Plate
Shell Plating 4/20 Plating
Casing 5/20 Angles 2" x 2" x 1/20 x 30" Spacing
Hatch Coaming 15" High x 5/20
Deck 4 1/2" x 2 1/2" Pine
Ceiling 6" x 2"
Lap Plates according to rules
Strengthening for Eyes according to rules
Keelsons 3" x 2 1/2" x 5/20
2" x 6" Planking

RIVETING

Longitudinal Seams	5/8" Rivet 2 5/8" & 2 3/4" C.C.
Stringer Plate Double	5/8" " x 2 3/4"
Keel, Stem & Stern Zig-zag	3/4" " 4"
Frames to Shell Single	5/8" " x 4 1/2"

MIDSHIP SECTION.



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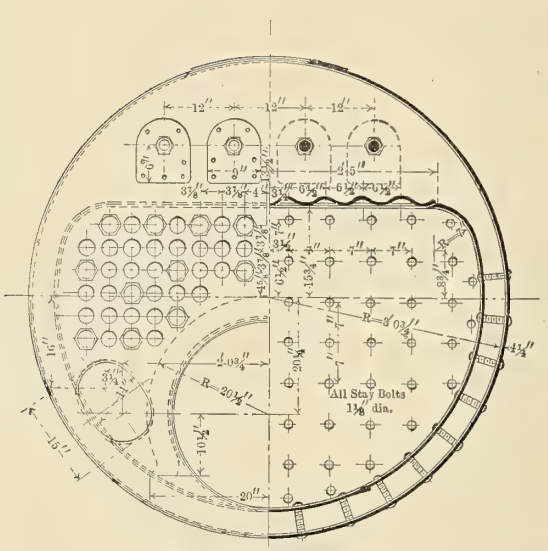
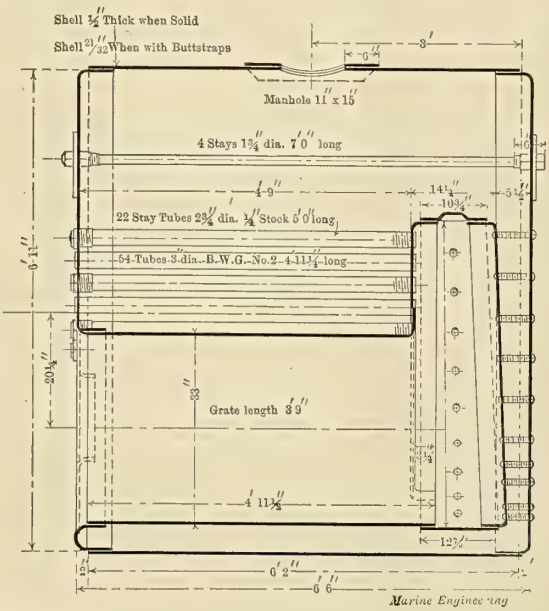


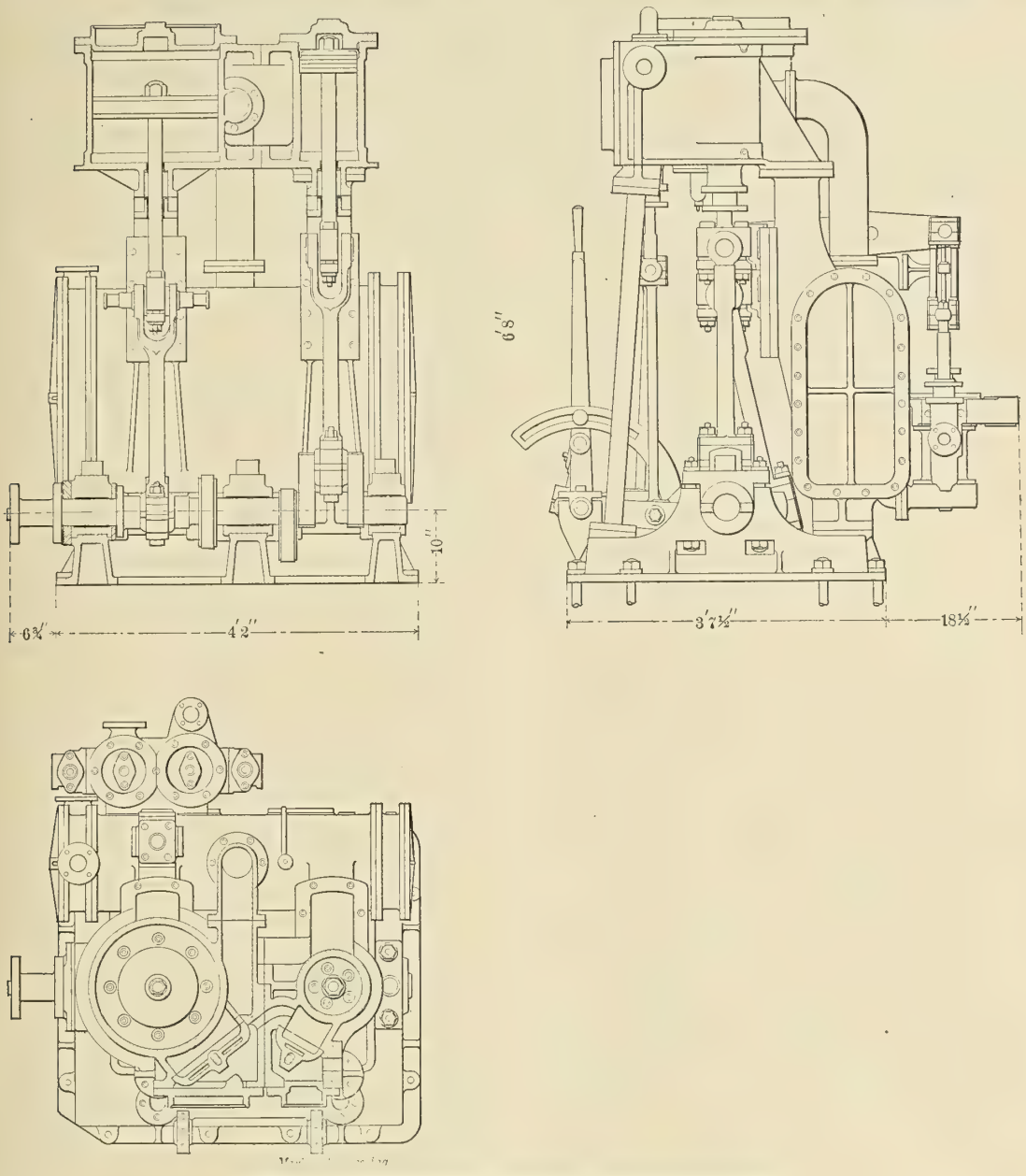

Shell 1/4" Thick when Solid
Shell 21/32" When with Buttstraps
Manhole 11" x 15"
4 Stays 1 3/4" dia. 7'0" long
22 Stay Tubes 2 3/4" dia. 1/4" Stock 5'0" long
54 Tubes 3" dia. B.W.G. No. 2 4 11 1/4" long
Grate length 3'9"
4' 11 1/2"
6' 2"
6' 6"

Marine Engineering

283 sq. ft. Tube heating surface.
62 " " Heating surface of other parts.
345 " " Total.
12 " " Grate surface.
140 lbs. working pressure.

BOILER, SINGLE PLATE SHELL,

NORWEGIAN FISHING STEAMER MJOLNER.



COMPOUND SURFACE-CONDENSER ENGINE FOR THE STEAMER MJOLNER.

plates without any longitudinal seam whatever. These shells are made by the Press und Walzwerk Actiengesellschaft, Düsseldorf, Reisholz, Germany, the only firm in the world that makes these solid rolled (not welded) shells up to 8-feet diameter. The process is the same as that of rolling a locomotive tire for driving wheels. By using such shells a reduction in thickness is allowed. The greatest gain, however, is the reduced risk of leaky rivet seams. The boiler furnace is ordinary plain welded, for corrugated furnaces are not in favor for small boats, as they are not so easy to clean.

All steam pipes to main engine and auxiliaries are taken from one solid cast-iron head, bolted with pin screws to a planed cast-steel saddle riveted to the shell. No steam dome or inside steam pipe is used, as experience shows that even in very boisterous weather no trouble arises.

The economy of this small machinery is surprisingly high—1.75 pounds of coal per I. H. P. per hour, not only on trial trips but in ordinary work. The trial speed of the boat is 9 knots, which generally answers to a sea speed of 8 1-4 knots. The price of the boat complete, fitted out for service, except fishing outfit, is about $9,000. The tonnage gross is 55.2 tons.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports 62 vessels of 23,358 gross tons built in the United States and officially numbered during the month of December, 1903. The largest steel steam vessels included in these figures are: *Missouri,* 7,914 gross tons; *Père Marquette 20,* 5,409 gross tons; *F. B. Squire,* 4,582 gross tons. The totals for the three calendar years are, 1903, 1,159 vessels, 381,970 gross tons; 1902, 1,262 vessels, 429,327 gross tons; 1901, 1,322 vessels, 376,129 gross tons.

SHIPYARD ECONOMIES.—II.

BY R. S. HUBBARD.

ORGANIZATION.

1. *Preparation and transmission of plans, lists, and other information to superintendents, foremen, and workmen* is accomplished by means of various systems. The best system is that one which has fewest weak points, and the weaknesses are usually:

(*a*) Inaccuracy or incompleteness, etc., of plans.

(*b*) Tardiness in preparation.

(*c*) Failures to note alterations.

(*d*) Losing or mislaying plans, etc.

While *a*, *b*, and *c* are specially drawing-room weaknesses, *d* is a difficulty which will always arrive, with its contingent delays, wherever drawings are not received, kept, and issued systematically in the yard. Each foreman's office can easily be provided with numbered racks or drawers, and a book kept to record names and numbers of plans and names of persons to whom issued. If alterations are made on yard plans, dated duplicate notes should be issued to the superintendent and the foremen who are responsible for carrying them out.

2. *Working understanding with owners' representatives.* It often happens that a great deal of trouble and expense is caused by the want of a proper understanding between the builders and owners' representatives. In the absence of any precedents, their relations are apt to degenerate into "get as much as possible" on one side and "give as little as possible" on the other. The following suggestions are made to indicate the direction in which a proper understanding may lie:

(*a*) As far as possible all plans and information issued by the chief draughtsman should be presented to the owners' representative for approval and signature.

(*b*) When thus approved and signed, the builders should not be asked for any deviation from them without an extra order.

(*c*) Owners' representatives should give the builders ample notice of any special requirements, tests, or the like which they wish to carry out.

(*d*) A responsible member of the builders' staff should receive any requests or complaints made by owners' representatives, and attend to them, but no interference by the latter with foremen or employees should be permitted or attempted.

(*e*) Owners should supply builders with plans and specifications of a thoroughly complete and detailed description, in the first instance to supply a proper basis for the builders' estimate and afterward to avoid misunderstandings and mistakes during the process of construction. From the builder's point of view this is absolutely essential to conservative business, while owners will invariably profit from the fact that the builder can cut his safety margin in making his bid if he is sure of his ground. The Navy Department, profiting by its large experience with contractors, has been steadily improving its specifications and providing more detailed plans and guidance sketches, with the result of avoiding disputes and facilitating the progress of the work. Builders who are asked to tender for new construction upon insufficient plans and specifications may possibly cover themselves by notes accompanying their bids explaining the nature of the assumptions that they have been obliged to make upon points not fully described or referred to in the plans and specifications provided. If the drawing up of plans and specifications is left to the shipbuilder it is just as necessary for the same reasons that they be most complete and specific.

The difficulties experienced in building private yachts are notorious in this respect, as it is generally difficult to convince the owner that a quart cannot be compressed into his particular pint pot.

3. *Systematic preparation and storage of fitting-out details*, if properly attended to, will result in considerable savings. This attention usually comes from the superintendent's assistants or not at all. It is very common to find construction or completion of vessels being delayed by the fittings not being to hand, and it is rather rare to find material properly collected and stored ahead of the ship's requirements. It is sometimes objected that the interest is lost on money locked up by finishing material before it is required, but the money lost by delays is generally a more serious item, and sometimes fittings get lost if storage room is inadequate or system is faulty, but this reflects on the store department and not on the principle of early preparation.

Complete lists of fitting-out details should not only be prepared by the "chasers" from the specifications and general plans, but progress made from day to day should be recorded. From examination of the "chaser's" list, a superintendent should be able to discover whether the plan for any detail had been issued or not, and what had been done with forgings, patterns, or castings; what number of fittings had been completed, and how many stored ready for the ship. The storekeeper should keep account of numbers stored, numbers issued, and location of articles in store.

4. *Scope of operations of various departments.* At first sight it would seem that clear definitions as to "scope" would not be particularly desirable, on the grounds that it would be inconvenient to debar any department from taking in hand work which it could turn out, when, at the moment, it might be in a satisfactory position for handling it. Actual experience, however, goes to show that when a shipyard is running satisfactorily and at its fullest output, any indefiniteness in this matter will result in each department trying to shirk the doubtful piece of work without saying very much, but keeping a good excuse ready. Questions as to scope are often raised between shipwrights and joiners, plumbers and machinists, shop machinists and brass finishers, riggers and carpenters, and so on. The most satisfactory principle on which to make settlements is that of "use and wont," so that when once a department has undertaken work of a particular character it is held responsible for it until further orders.

5. *Efficient supervision.* While this subject has been touched upon in previous sections, it is of such vital importance that a few remarks on the work done by assistant superintendents, head foremen, and "chasers" will not be superfluous. There is often a good deal of talent and ambition to be found among these officials, but, apart from their jealousies, incompatibilities, and rivalries, the clashing of their authorities sometimes discounts their efficiency. Systems vary so much that remarks upon this point may only be of a general nature,

but it seems best that while head foremen must retain control of their own departments and be responsible for economical output and the efficient handling of their workmen, the superintendent's assistants should exercise certain powers in directing the course of the work, maintaining discipline and order, and obtaining and disseminating information.

The systematic working of a shipyard renders a large amount of listing-up work, records, and notifications in writing absolutely necessary, but it would seem that the best work can be turned out by a few really capable men rather than by a number of less competent ones. The latter naturally tend to become tied up in the red tape of an elaborate system, while the former can use a system as it should be used—as a weapon for the removal of difficulties and effecting economy of labor. While some hold the opinion that it is desirable to concentrate authority in a few first-rate minds capable of controlling many inferior ones, there seems to be one qualification. It is not safe to make any department of a shipyard dependent for its good working upon one mind alone, because absence, sickness, or other causes may then so easily impair that department's efficiency. In some large plants the necessary safeguard has been found in an "understudy" system. Each departmental head is provided with an assistant and successor who qualifies himself for undertaking his chief's responsibilities in case of his absence.

6. *Standardization and specialization.* It is difficult to over-emphasize the importance of standardization among the factors which tend toward shipyard economy, but up to the present it has seemed next to impossible for American shipbuilders to practice it. Small plants may be seen undertaking contracts which are in reality beyond their capacity and occupy them for years, while large plants build tugboats and car floats. It is possible that the realization of the fact that this state of things is injurious to all parties will cause a reaction in the future, and standardization in type will become recognised. Some shipyards in Britain have specialized on tramp steamers to such an extent that considerably lower prices are quoted to shipowners if they are willing to accept the standard design of the yard. Thus, while the shipowner can be quite sure of what will be supplied him by informing himself as to the performance of the previous vessel of the same type, the shipbuilder can figure upon a safe profit.

Firms doing warship and first-class mercantile work are in a similar position, although standardization is more a result of the regular practice of the government and the steamship owners than any achievement of the shipbuilder. Standardization and specialization are profitable not only from the fact that old drawings, patterns, and matrices, steel and lumber stock, etc., may be made use of again, but also because the staff and regular hands become accustomed to the class of work and can push it through with more promptitude and certainty.

Specialization has another aspect in its application to labor. As an example of this, it is easily realized that a shipwright who has been steadily laying decks and fastening chocks and fairleads on succeeding vessels will become more expert in this branch than his fellow-shipwright who has been laying keel blocks, shoring and fairing for some months. Thus it is always found economical to keep under foremen and their gangs moving from ship to ship doing a certain section of the work.

The work which has been done of late by the Bureau of Construction and Repair in standardizing such details as air ports, water-tight doors, valves, pipe sizes, and very many other fittings can scarcely be spoken of too highly; as apart from the many advantages which the system affords to the Navy Department itself, the savings which builders of war ships will gradually effect on succeeding ships will become more and more apparent.

ARRANGEMENT OF BUILDINGS AND YARD.

The limitations of human foresight are such that the general arrangement of a plant usually seems economically defective in some respects whether it is an old one or of the most recent design. Sometimes the defects are inherent in the site and geographical features, and sometimes in the arrangement or want of arrangement, but not infrequently they can gradually be overcome in the process of development or extension.

While special circumstances call for special treatment a few general principles may be considered. It is obvious that the fitters' shed must be close to the building slips, though it should not be so close as to hamper transport; and if there is any choice in the matter the longest ships should be nearest the shed, on the principle that the heaviest material should have the most convenient road to travel. The beam shed seems to call for the next preference in the matter of convenience for the building slips, and the angle and shape smithy ought to adjoin it. The steel yard comes next in order, its natural position being on the sides of the foregoing buildings farthest from the building slips. The fitting-out basin or wharf should never divide the building slips if it can be avoided, although it is a great advantage to have a few punches, shears, and fixed drilling machines within easy reach of it. It is also convenient to have wharves and access to both sides of the basin. The store department should be near both building slips and basin, and the car tracks should pass if not enter it.

The sawmill demands a position near the water and the road and must be reached by the car tracks. The wood yard should be next to it, and the joiners' shop and pattern shop should open on to the wood yard if possible. Yard machinists' shop, paint shop, and carpenters' shop should be placed near building slips and basin; coppersmiths, pipe fitters, plumbers and sheet-iron workers can be housed a little more remotely. Engine works and boiler shops need not be near the fitting-out basin if the car tracks are convenient, and offices of all kinds naturally come next the road. The mold loft comes best between the offices and the road. The smithy and forge, if arranged for the work of both departments, should occupy a central position.

Compactness of arrangement is essential, not only because it reduces distances for transport and actual land areas, but because it economizes the time and energies of the superintending staff and makes communication between the members more easy. A telephone system between the main offices and all departments of the yard is also a great convenience in this respect.

It is not by any means essential that the joiners' shop,

pattern shop, yard machinists' shop, riggers' loft, or mold loft should be on the ground level; in fact, on account of this consideration of compactness, it is generally an advantage to place them on a floor or in galleries above the ground; and in constructing new buildings it is a good general rule to build them of two or more stories even if the space above is not immediately required. Other departments which are better placed on the second floor are the store for electrical fittings, finished joiner-work store, pattern store, and plumbers' and pipe fitters' store. It is of course usual as well as desirable to have drawing rooms and photographing rooms upstairs.

In the construction of new buildings fire risks should be kept well in view, brick dividing walls or open spaces being necessary for cutting up the space into comparatively small units, but easy communication being preserved by fire-proof doors and the like. Most modern plants are now equipped with sprinkler systems and a private fire-pumping station piped to convenient hydrants. All these precautions have an economy in reducing fire insurance premiums even if no fires actually occur.

2. *Use of power-driven portable tools worked by cheap labor.* Although it does not by any means follow that because an equipment of portable pneumatic, electric, or hydraulic tools is being used for carrying out riveting, calking, etc., economy is being effected in these operations, yet the advantages may be very considerable under certain circumstances. The following table gives some results actually obtained in practice with hand and pneumatic riveting, although it is not claimed that results are invariably as satisfactory.

Gang A was a hand gang, consisting of 2 riveters, 1 holder-on, and 1 heater; Gang B used pneumatic riveter and consisted of 1 riveter, 1 holder-on, and 1 heater.

	Gang A.	Gang B.
Rivets put in per day; 3-4-inch diameter, straight work	396	388
Wages of heater per day	$1.84	$1.34
Wages of holder-on per day	3.00	2.34
Wages of each riveter per day	4.51	3.11
Wages of each gang per day	13.86	6.79
Price of labor, per rivet	.035	.0175
Pneumatic tool. Estimate of expenses chargeable to interest and depreciation on pneumatic plant, cost of driving power and attendance, wear and tear of service, air pipes, storage, repairs and attention to tool, per day	..	1.74
Same, per rivet	..	.0045
Total cost per rivet, ex. counting and testing	.035	.022

What losses there are are generally caused by the frequent leakages of air or water under pressure and by bad contacts and defective insulation in electric wiring. Loss due to undue resistance is sometimes caused by insufficient sectional area in the mains.

It is owing to the fact that pneumatic riveting can be satisfactorily carried out by cheap labor that it can sometimes be made profitable, as skilled men would not be satisfied with the wages they could earn at the lower rates paid. Unskilled men employed on calking and chipping are seldom able to keep their chisels, cutters, etc., in good order, and in any case a shop for "fettling" tools and keeping the hammers and drills in repair is a necessity. It may sometimes be combined with that required for other departments. Pneumatic power is, generally speaking, the most flexible and best adapted for the work on board the ships, although it has the disadvantages of occasionally freezing up in very cold weather and of costing a good deal for hose and repairs; at the same time electricity is very satisfactory as a motive power for all kinds of drilling, and tools driven by electric motors are almost necessary for boring out, facing up, cutting circular holes of large diameter, etc. Hydraulic manhole punches, shape cutters, flangers, and frame riveters seem to be still the best tools for their particular purposes.

3. *Power station economies.* In small plants it is generally customary and economical to concentrate the power generators in one station near the fitters' shed, but where the area is large and power distribution takes place at a long distance from the point of generation some subdivision is advantageous. In one large plant the fitters' shed, joiners' shop, smithy, and hydraulic plant were grouped together for the power supply, while the machinists' shed, saw mill, electric-lighting plant, heavy cranes, etc., were driven by a second station. As the distance between the steam hammers in the smithy and the saw-mill engine was more than a quarter of a mile, the reason for duplication is obvious. In some plants, on the other hand, small boilers and engines are to be found scattered in all directions, and the losses from the multiplication of engineers, transportation of fuel, etc., more than counterbalance the gains from reduction of distances.

Without entering into any arguments upon the relative merits of automatic stokers and hand firing, water-tube boilers and forced draft against fire-tubes and high chimneys, independent motors instead of long lines of shafting, and the like, it may be suggested that a few tests are sometimes very instructive. Indicator cards should occasionally be taken from an engine driving shafting when the tools are not being used, the resistance of the leads to independent motors may be tested from time to time, power station fuel consumption may be checked, and also fuel consumption for forge and fitters' shed furnaces.

Where hydraulic lifting appliances are used the power drawn from the pumping engine is usually the same for each operation of the ram, whether 3 tons or 300 pounds are being lifted. As it is not convenient to enforce rules which would keep the crane or derrick waiting for a full load these appliances, though useful, are often wasteful.

If one boiler is fitted with a furnace designed to burn sawdust, shavings, chips, and other refuse more expensive fuel is saved, and the arrangement is convenient as a rubbish destructor.

4. *Transportation.* Economies derived from the use of cheap labor for transportation service have already been remarked upon, but other possibilities exist in connection with the reduction of the amount of transportation and the mechanical means employed. Under ideally perfect conditions steel, lumber, and other material entering the yard would be unloaded so that it could be selected and transferred to the machines without hand labor, and, when prepared, removed to its position in the ship by mechanical means; but it generally happens that such perfection would only be attained by a

too great outlay on plant. A small outlay, however, will pay for means of stacking plates on edge for convenience of selection. Smooth roads may be preserved and kept clear for moving the steel, etc., on hand barrows if narrow-gauge rails and bogies are not among the resources of the plant. A steel wire span with a traveler and winch will prove a fairly good substitute for an overhead crane for small and moderate-sized vessels, and means can generally be arranged for stacking lumber close to the car lines and yet convenient for the saws or deck planer.

Transportation of armor plates is a consideration of a special kind and must be governed to a great extent by the features peculiar to the plant. If delivery can be obtained in time it is generally advantageous to fit at least the lowest tier of plates in the ship before the launch, even although the extra weight of the vessel may somewhat increase the expense and risk of the launching operations. Although in some plants it may be possible to lift the plates to their berths without floating them, the work is not so conveniently done from floating stages, and the necessity of fitting both sides of the ship simultaneously to avoid a heavy list is often a drawback. Installing the engines and boilers has also sometimes to be delayed to prevent the vessel sinking to a water line above the level of the armor shelf.

The advantage of having car tracks beside the building slips comes out strongly in this connection, as the plates can then be laid out for making molds for trimming sheathing in positions quite near the plate berths.

5. *Arrangement of power-driven fixed tools.* Although it would be inappropriate to discuss such arrangements as would involve radical alterations to an existing plant, the fact that new tools are often added to and old tools moved in plants already established, suggests the comment that all such changes should be made in accordance with a scheme which takes account of possible improvements to the existing facilities and of the nature of the work which is likely to be undertaken in the future.

The steel work of small vessels is sometimes let to piece fitters in a lump contract covering the whole of the work, while that of large vessels requires to be more or less subdivided among several large gangs. In either case that arrangement of the tools is most advantageous which admits of the large jobs like framing and bulkheads, shell plating, deck plating, and casings being carried out with a minimum of transportation from one fixed tool to another, and without causing the work of any one gang to be delayed by waiting for the use of a tool which is being operated by another gang. Time and labor will therefore be economized if the framing plant, including shape cutter, vertical and horizontal punches, furnace and angle beveller, manhole punch and floor shears are arranged in a convenient bay or line; the plating plant, including plate furnace and accessories, combined punch and shears, flanger, mangle, rolls, countersinker, scarphers, planers, etc., in a second bay; while the plain plating and jobbing departments have a third outfit of tools.

In the joiners' shop something of the sort can also be done by arranging saws, planers, face and edge machines, mortise and tenon machines, dovetailers, spindle cutters, and molding running machines in a consecutive order, so that the wood may be handed direct from one machine to another without being carried over the same ground twice.

In shipyard machinist shops the work is so varied that no probable order of operations can easily be mapped out, and the best practice seems to be simply to place like machines with like—lathes together, planes together, and so on—with a fast overhead crane to move the material about.

6. *Upkeep and new construction.* The economy of good upkeep is generally most appreciated when a breakdown has occurred during a special rush and the repair gang is working night and day to get into running shape again. An annual or half-yearly holiday shut down of a few days gives an excellent opportunity for blowing-down, inspecting scaling, and repairing boilers, opening up the main engines, inspecting and repairing furnaces, and so on, besides having other advantages. Although the practice is by no means general some firms employ a plant superintendent or master of works who is responsible for all repairs and new construction, and incidentally for any delay resulting from failure to keep running. Nothing is lost by keeping spare parts of engines, shop shafting, and, in fact, spares for all working parts which have a special habit of breaking down. Upkeep of standing plant, such as buildings, tracks, water front, power mains, etc., can usually be attended to "piecemeal" during the ordinary running hours; repairs which involve delays can be prepared for but carried out when general work is suspended. The master of works will be able to undertake most of the new construction in an established plant, and it is generally accepted that buildings, etc., should be substantial enough to stand for 20 years.

7. *Shop economies.* It is a general principle that work which can be carried out in the shops (with their advantages of machine tools, good benches, and greater comfort for the men) should not be done on board the ships; but the principle should be pushed even further with safety—work which can be done by outside subcontractors at a less price, made possible by specialized tools or organization, should not be done in the shops. This latter consideration applies very frequently in the case of air ports, certain makes of water-tight doors and their gears, valves for plumbing and pipe fitting, lifeboats and rafts, heavy davits, and many other fittings which would generally be undertaken by the shipbuilder if his plant were sufficiently specialized. There are, however, some few economies in connection with certain of the shops which deserve mention.

a. Joiner Shop. The men should not require or be permitted to leave the shop in the ordinary course of work, nor to hang about the machines unless their presence is required by the machine man who is preparing the material they are to work. As a general rule, however, they should only need to mark the wood for machining, leaving it beside the machine and removing it when finished with.

As in all cases, the peculiar abilities of the men should be looked out for and developed. Some are specially good at heavy work like skylights, companionways, and deck houses; others excel in turning out a long order of plain work like panelling or doors;

others, again, are at their best on fine work like hardwood furniture which is to be polished.

The joiner shop has been referred to before as a good field for the introduction of piecework or premium system; although rare in shipyards, piecework is frequently adopted in car works, house building, etc. In drawing out the details care should be taken to avoid curved work as much as possible, as the curves involve waste of material. Inferior qualities or cheaper kinds of lumber should always be ordered for backs and interior fittings, and as special prices have to be paid for extra widths, etc., in cut lumber, dimensions of parts require to be kept down. Although not at present adopted in all shipyards the sand-papering machine and hand-worked tools for miter cutting save a great deal of time and labor.

Chairs, tables, mirrors, and other fittings generally used in houses can often be bought outside more cheaply than they can be made in a shipyard joiner shop.

b. Carpenters' Shop. Although it is often thought that shipwrights do not require a shop to work in there are certain jobs which are much better done under cover, even if the "shop" is only an extension of the spar shed. The carpenter shop should have racks for the stowage of tool chests, a circular saw, and perhaps a planer, a plug-cutting machine, an auger-drilling machine, and a grindstone, and the foreman's office should be at the end of it. In this shop bolted hatches, etc., can be made, wedges and slivers cut and stored, molds made, boat's chocks prepared, and many odd jobs conveniently taken in hand.

c. Yard Machinists' Shop. In a good many plants no shop is exclusively devoted to yard machinists' work, the engine works being supposed to undertake all machining and vise work for the yard, charging time and material to shipyard account. Even in small plants, however, this plan seldom works well, and in large plants it is generally pernicious. Water-tight doors and their fittings, hinges and dogs for non-water-tight doors, and all kinds of smith finishing work, fittings for gun-port doors, gangway doors, hatches and steel skylights, drilling and countersinking of holes, and many other detail jobs for hull work do not call for great accuracy in the matter of finish. The workmen require to be trained to turn out jobs with rapidity rather than with great refinement and to know the special requirements of hull work, while a lighter class of tools is better adapted for doing hull jobs. It is natural for the engine-works foremen to regard the hull details as a secondary matter, and the charges for labor are generally found to be excessive. A yard machinist department with an independent shop avoids division of authority and is really an economy in spite of the duplication which would at first sight appear to be disadvantageous.

d. Blacksmith Shop. Smith work can be and often is done by piecework and the system is quite satisfactory, but the greatest source of economy at the present time is the introduction of the drop hammer and standard dies and automatic bolt machines. While it is possible to do a good deal of die work under a light steam hammer, large numbers of similar details and fittings for hull work can most conveniently be done under the drop hammer by piecework and at very cheap rates. The initial cost of the dies is covered in a very short time, generally in the first fifty of an order. An automatic bolt machine, once introduced, will be found at work continuously. In designing blacksmith details, however, expense can often be saved by making use of steel castings where it used to be customary to put in wrought-iron fittings. Female portions of hinges, sockets of various kinds, stowing and lashing eyes and pads, parts of turnbuckles, brackets, etc., are now in many cases made of steel when the number is sufficient to pay for the pattern making.

e. Pattern Shop. A good foreman pattern maker will effect marked economies by attention to two or three points. While good material and good finish is required for many of the smaller patterns a number of the large patterns, being used only a few times by the molder, can quite well be made of very rough material and finished roughly. It is possible to save a great deal also by making skeleton patterns wherever they will serve the purpose, especially for pipe bends and sea connections, bushings, and the like. As a great many patterns are of no further use after being used for their special purpose it is a good plan to have them conveniently stored so that they may easily be looked out and altered according to requirements when something near their shape is called for.

MATERIALS.

1. *Orders and deliveries.* So much of the success of shipbuilding depends upon the prompt and well-timed delivery of material that the efficient working of the purchasing agent's department possesses great importance. The secret of satisfactory delivery depends in a great measure upon the requisitions being made in good time, but also upon the judicious placing of the order. It is not an unusual thing to find that some item requiring early order has been overlooked until the vessel is nearing completion or has been shelved for want of information. It is easy, however, to prepare a key schedule or index from the original plans and specifications, placing the name of the department responsible for the requisition and the probable date required opposite each item. If this schedule is kept annotated by the purchasing agent an occasional inspection of it will prevent surprises. In asking quotations the date when delivery is required should of course be stated on the inquiry, and if subcontractors overrun their time correspondence should commence at once.

2. *Store department organization.* Labor can be saved within this department itself by good arrangements and convenient weighing and lifting apparatus, but the greatest economies result from an organization which keeps perfect account of stock and produces it promptly on demand. The numbers and locations of all articles of outfit, equipment, etc., can be very easily kept account of by means of a suitable card file; bolts, rivets, screws, and nails, oakum, tallow, and the like, are better kept by receipt and issue books.

Foremen should be immediately notified of the arrival of special materials or articles ordered for their departments, and the purchasing department should arrange that all material is properly marked with the number of the hull for which it is required, by the firm supplying it, for purposes of identification.

Although as a general rule very little material should be carried as general stock, certain sizes of bolts and nuts, screws of standard thread, rubber, and some other articles are so frequently called for that a few exceptions may be made, and weekly replace requisitions from the store department take the place of the usual drawing-room requisitions. This method prevents the delay which sometimes occurs when very small orders are placed outside. No material should be issued under any circumstances to workmen who have not presented a properly filled in "line" from their foreman.

3. *Saw mill and wood yard organization.* Although a log-cutting saw mill in a shipyard is a great convenience when special sizes of cut lumber are required on short order, it seldom shows any book advantage. Monthly accounts generally show that the lumber merchant can supply the cut stuff quite as cheaply as the shipyard mill, and make his own profit besides, and very little reflection will make the reason clear. If, however, as sometimes happens, a saw mill doing a general business is run beside and in conjunction with a shipbuilding plant, the latter reaps an advantage without detriment to the former. The whole of a cheap lot of logs can then be bought instead of the net quantity for shipyard requirements, and the mill is not so likely to be frequently running at reduced output. In order to cut logs profitably they must generally be cut *for what is in them,* while the mill run for shipbuilding purposes exclusively requires to cut the logs to obtain certain sizes of lumber.

The wood yard is best divided into two departments, in one of which lumber is stacked for joiners and pattern makers, principally under cover, while the other deals with the material required for shipwrights and general yard purposes. Workmen should not be sent to the wood yard to select and cut out their own pieces, but orders should be handed in to the wood-yard clerk by the various foremen, the wood-yard staff breaking out the stuff and delivering it as required. The necessity for this arises from the fact that a workman will always pick out the best and cleanest piece of material he can find for his purpose, without much if any regard to what he leaves or the quality of timber his job really requires.

4. *Steel and iron-yard organization.* While a great deal of time is often wasted by bad stacking and insufficient means for handling plates and shapes, the fact that steel and iron is usually ordered from the steelmakers to scheduled sizes prevents or should prevent much waste of the material. It is always necessary to keep a certain amount of stock, however, and it is in the careful management of this that economies can often be secured. Small quantities of material are generally left over after the completion of a hull, and these leavings will accumulate and rust into uselessness unless properly looked after. A stock book should be kept by the iron measurer and daily account taken of all receipts and issues. A corresponding book should be kept in the drawing room, daily changes viséd and signed for by the chief draftsman, and new orders of material for stock checked by comparison with the sizes at present on hand. An alteration will often throw a batch of material into the stock book for an unavoidable reason, but unless the sizes or sections are very unusual, a use will very soon be found for them if not overlooked. Here, as in the store department, all issues of material should be made by foreman's order sheet and cuttings returned.

In conclusion it may be remarked that shipbuilding being an industry full of the most multifarious detail, economy is the result of attention to the small things rather than to the broad generalizations of design and organization. If work were always done correctly at the first attempt, if nothing were ever forgotten, and if cost accounts were always completely rendered, shipbuilding could be made to pay without regard to "trash about details"; but human nature being as it is, the patient and laborious qualities succeed in shipbuilding where superficial brilliance ignominiously fails.

Construction of Line Shafting.

BY H. E. RAABE.

The number of breakdowns of marine shafting and the repairs thereto are the subject of almost continuous discussions in the technical journals, and yet there is practically no deviation from the old rules and formulae, and new ships are coming out with shafts built on the same lines as those years ago. The shafts of large steamships continue to break, and there appears to have been little effort made to rectify this most annoying breakdown.

Spring couplings for small shafts have been devised, which have proved satisfactory, but no spring coupling has ever been applied to a heavy shaft with any degree of success.

The breaking of a line shaft of a steamship is actually not the worst breakdown that can happen at sea, providing the engine is slowed down before it has time to race itself to pieces, which the wideawake engineer on watch always manages to prevent, and providing the shaft breaks "where we want it to." No engineer, however, wishes his shaft to break, no matter in what place, no more than a motorman of a trolley car wishes his armature winding, etc., to burn out. Designers of trolley cars, however, know that this is unavoidable, no matter what the conditions may be; on an even grade, with probably an empty car and perfectly dry weather, all of a sudden "a fuse blows;" well, that is what the fuse is there for; if the fuse were not there, probably the whole armature winding would burn out, or receive a puncture somewhere sufficient to put the car out of commission. With the fuse, however, the motorman makes the necessary repair on the spot and in a few seconds.

Now this great convenience to repair a trolley car exists regardless of the fact that there are plenty of "cars ahead" and "cars behind." A steamship, however, is sent out to sea without any convenient method of repair, except a few tools and a few spare parts, which sometimes do not fit, as described in MARINE ENGINEERING of November, 1903, in the account of the breakdown on board the German steamship *Syracusa,* where the holes in the coupling of the spare shaft did not correspond with the holes in the coupling of the section which was in service.

While the writer does not intend to urge designers of steam vessels to put a safety plug into a shaft, yet, since the shafts have the habit of breaking, in most cases

either inside of a bearing or close to a coupling, he would like to offer a few suggestions that may be of some value to some one interested in this subject.

A method often employed to construct line shafting for a steam vessel is shown in Fig. 1. This form is very frequently employed in small and medium-sized shafting; the writer has also found it on large sizes up to 20 inches in diameter. The shaft is turned off and finished only at the ends, where the couplings are to be shrunk on, and also in places where the bearings happen to come. The rest of the shaft is left rough. It would be a waste of time to turn the shaft from end to end, and, besides, the rough surface is much easier to paint than the finished surface would be.

This is a good and common-sense argument on the part of the builder, who figures on the cost; however, the operating engineer at sea, after reading this article, will naturally think quite differently. One day the writer called on a marine engine builder who has a high reputation for his good workmanship; one of the men in the shop was just finishing the ends of an 8-inch line shaft previous to fitting the couplings. The shaft was 8 inches in diameter in the rough, and 7 13-16 inches at the finished ends; and as the shaft called for should have only been 7 3-4 inches, the owner of the shop thought he was giving his customer a very liberal allowance for his money. Upon being asked if he did not consider this form of shafting rather faulty, he promptly replied, "No; if you turn the shaft from end to end, you lose the best of the stock, which is near the surface of the shaft, at the same time you decrease the diameter of the shaft, so you naturally must see that this is the stronger shaft." Well, this certainly is true, outside of the bearings and the couplings, but is it possible to make a shaft any stronger than its weakest point? The weakest point naturally will be at the ends of the coupling hubs, where, besides the reduction in diameter, the cross section is reduced by a few good effective square inches on account of the keyway.

If such a shaft should break, it will almost invariably break inside of a bearing, or close to a coupling, where it will be very difficult to make the necessary repair.

In Fig. 2 is shown a somewhat better construction of shafting; in this case the ends, which are turned to receive the couplings, are upset, thus the section is increased; the same should also be done with the journals.

Wherever this form is used, the tendency is always to make the upset ends too short, and to make the increase in diameter too abrupt; thus the shaft has an even chance to break at either *A* or *B*, Fig. 3; in fact, the tendency is to break at *A*, just where the sudden increase in diameter occurs. The reason for this is, that, due to the strains caused by unequal expansion when the forging is being cooled, the weakest part of the shaft is at *A*. In a case like this, the break is just as bad as it would be in a shaft of the kind shown in Fig. 1. The amount of shaft projecting beyond the coupling or bearing is not sufficient to properly attach any device for emergency repair, and thus repairing will be very difficult and unsatisfactory.

An improvement on the foregoing design is shown in Fig. 6; here the upset ends are continued beyond the coupling for a considerable distance, and instead of being reduced abruptly, the diameter changes gradually, thus lessening the danger of shrinkage flaws. For good practice, the parallel part of the large diameter should be carried beyond the coupling and each end of a bearing an amount equal to the diameter of the shaft, and the tapering part should be at least as long as the radius of the shaft. It will plainly be seen from the figure that the weakest part of the shaft, in this case, is

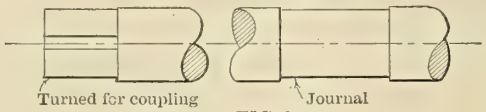


FIG. 1

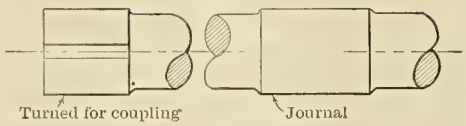


FIG. 2

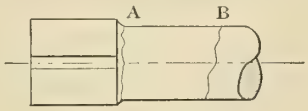


FIG. 3

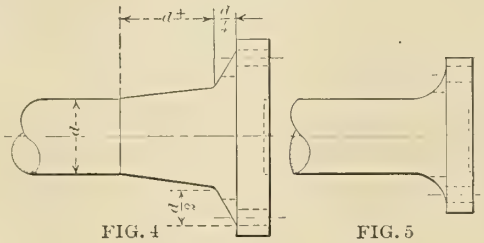


FIG. 4 FIG. 5

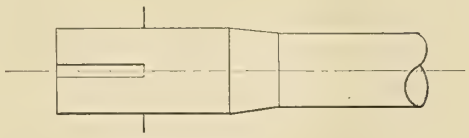


FIG. 6

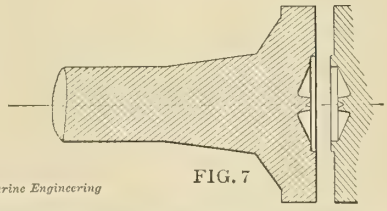


FIG. 7

very easy of access, and the chances of repairing a break are far better than in the former cases.

The custom to-day is to forge the shaft and coupling in one piece, which is very good practice, as the diameter of the couplings is reduced considerably, decreasing their weight; besides this, there are many other advantages, upon which we cannot dwell in this article. The tendency, however, is to make the coupling flanges too thin, with regard to the diameter of the shaft, at the same time also making the junction between shaft and flange too abrupt; both of these mistakes will cause a weak spot in the shaft, where repair work is very difficult.

An improved form for this kind of a coupling is shown in Fig. 4; here the flange is made with a larger diameter than is customary, in order to obtain the proper width for the bolt heads and nuts. Instead of the usual circular fillet at the junction, the diameter of the shaft is first gradually increased toward the coupling for a length at least equal to the diameter of the shaft. This taper is met by a libral fillet, which runs into a conical outline, and finally meets the parallel part with an easy curve. The flange in this case is made much heavier than usually. The writer has seen shafts, with solid couplings, of a design shown in Fig. 5, where the radius of the fillet was almost as long as the width of the flange, and the bolt heads and nuts were set into recesses, countersunk into the fillets. The designer of such a shaft evidently bore in mind the strains due to unequal expansion, and tried to overcome the abrupt junction by a large fillet. In this design, however, a large bulk of metal is placed at a point where the metal should be reduced, and that gradually.

In Fig. 7 is shown a longitudinal section for a solid cast-steel shaft, with solid couplings. Here the same outline is used as in Fig. 4, except that it is still more pronounced; the center of the coupling, however, is taken out for a considerable distance, in order to make the change from one shape into the other still more gradual, which is very important for cast steel. In order to avoid the use of a false center in turning such a shaft, it is advisable to allow a boss to project as shown.

The journals for these shafts, as well as those forged with solid couplings, should be constructed as those for the shaft in Fig. 6.

Fishermen's Way of Raising a Boat.

In comparison with the elaborate outfit of a ship wrecking company, I was struck with the simple but effective means adopted by the boatmen of the Penobscot bay region to raise a fishing boat off Swan's island, near Mt. Desert, Maine, during the summer of 1903. No appliances, except their own primative methods and native common sense, were used in the undertaking.

The boat was an ordinary fishing boat, sloop rigged, with about two tons of pig iron ballast on board. She was overturned in a heavy gale and sunk in about 60 fathoms of water and in a channel where the tide runs free and strong. The securing of a diver and his outfit from the city would be an expensive undertaking, especially as finding the vessel was an uncertainty. The

RAISING A SUNKEN FISHING BOAT OFF THE COAST OF MAINE.

method adopted by the fishermen was as follows: Two ordinary fishing boats, the same type as the one which was lost, started sailing down the channel about 200 feet apart. Between them was stretched a heavy cod line heavily weighted so that it dragged on the bottom. The vessels sailed along parallel to each other backward and forward until the obstruction was found. From the fishermen's experience they seemed to know whether the obstruction below was the boat they were after or not. In this case it was the boat.

A life line was then used to carry below a one-inch rope, which was weighted and carried round and round the sunken vessel by one of the boats sailing in a circle. In this case the fishermen succeeded in getting the line around both bow and stern and around the mast as well. Two larger fishing vessels were then brought up abreast to each other about a dozen feet apart, as will be seen in the picture, and a stout spar or timber was placed

across their decks. The two ends of the rope were attached to this spar, which was slowly turned over by hand power, winding the rope around it until the mast of the sunken boat appeared above water. The mast was pulled from its socket, but the shrouds and rigging held it fast until the bow appeared above the surface. Then additional lines were made fast around the bow and the vessel was supported almost vertically.

An anchor from one of the boats was now carried inshore by a small boat, the full length of the cable, and by heaving on the cable all three vessels were worked inshore. The anchor was then raised and carried inshore again, and the operation repeated until finally the vessels were brought at high tide to a shallow spot off shore, when in the receding tide all three were beached. On the next tide the two sound boats were, of course, warped out, while the sunken one was warped in on the beach, and found to be scarcely damaged; even the compass, which lay on a seat near the steering wheel, was intact. There were only a few scratches along the keel and a slight dent in the rudder. The ballast, of course, shifted more or less, but nothing was damaged, not even the rigging, except a tear in the mainsail, and the mast displaced, as above mentioned.

Although this method of raising a boat is quite common in this region, it is seldom successful because of the difficulty in finding the sunken vessel, or when found, to get a strong enough hold on her to allow of raising her, weighted down as she is with ballast, etc. In this case the operation took 26 hours of continuous work, during which time none of the boatmen left their positions.

Six Months' Shipbuilding Returns.—The Bureau of Navigation reports 571 sail and steam vessels of 177,067 gross tons built in the United States and officially numbered during the six months ended December 31, 1903. During the corresponding six months ended December 31, 1902, 627 sail and steam vessels of 171,599 gross tons were built in the United States and officially numbered.

Notes on Shipbuilding Facilities of San Francisco.

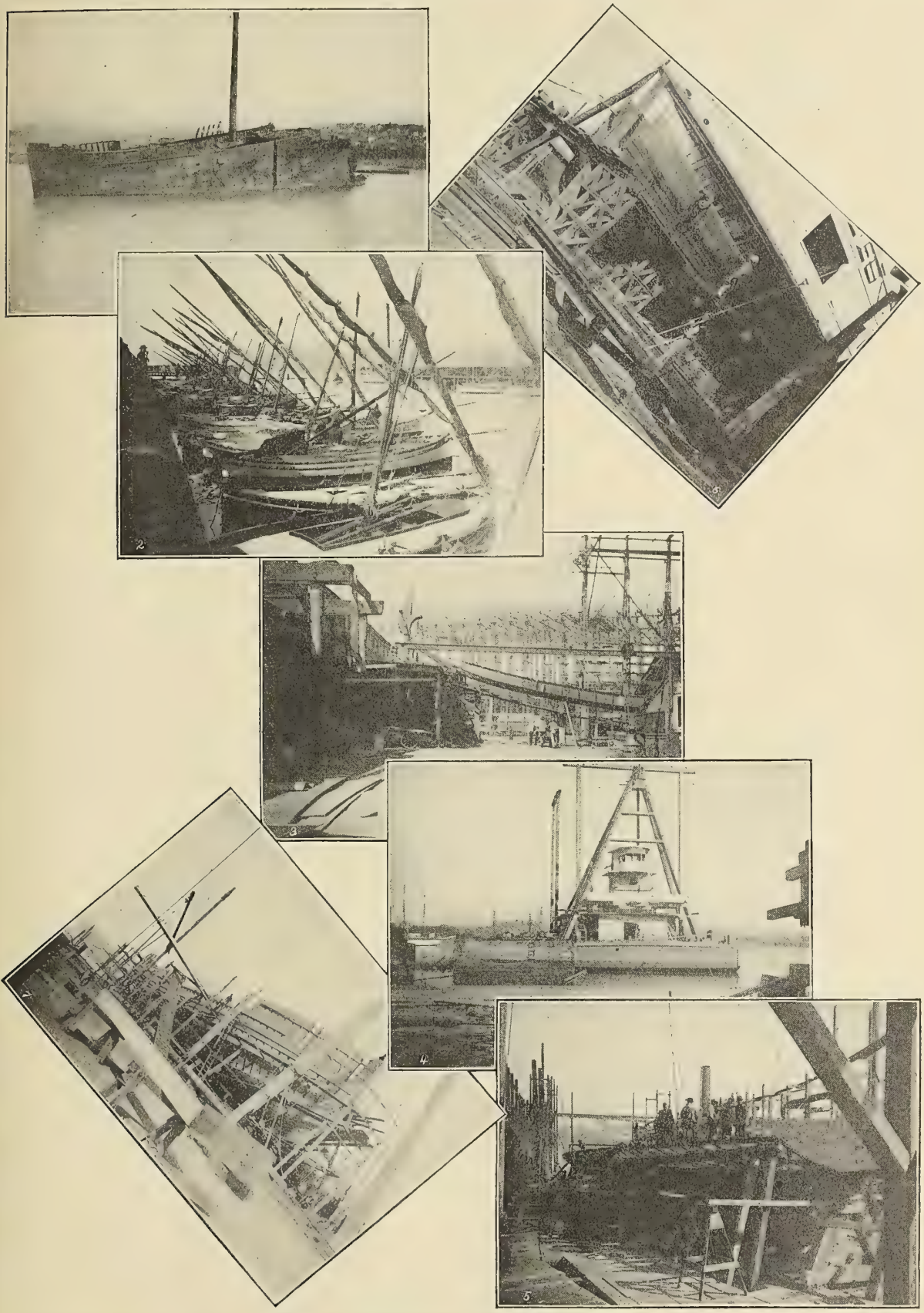
BY H. H. BAILEY.

There are in all five shipyards in and about San Francisco which are equipped for building large steel vessels and for carrying on a large amount of repair work. Three of them are located on the San Francisco side of the bay, while the other two are on the Oakland or eastern side of the bay. Up to very recently all the yards on the coast have been severely handicapped, due to the great distance separating them from the coal mines and steel mills of the East, but since oil has come generally into use as a fuel, the yards are now using liquid fuel in boilers and furnaces, thus solving the fuel problem. The fact, however, that all the steel must be brought from mills in Pennsylvania, which generally takes from five to six weeks, still remains a serious handicap.

Most of the vessels for the Pacific harbor, coast, and ocean service, flying the American flag, have been built in these yards. Two of the yards also carry on a large business outside of shipbuilding. The port is well provided with dry-docking facilities, as there is one company which operates six marine railways, and other companies which operate three large dry-docks, three floating dry-docks, a marine railway at Alameda, and a large railway at Oakland. At the present time work on the coast is rather slow and there are no immediate prospects for new contracts.

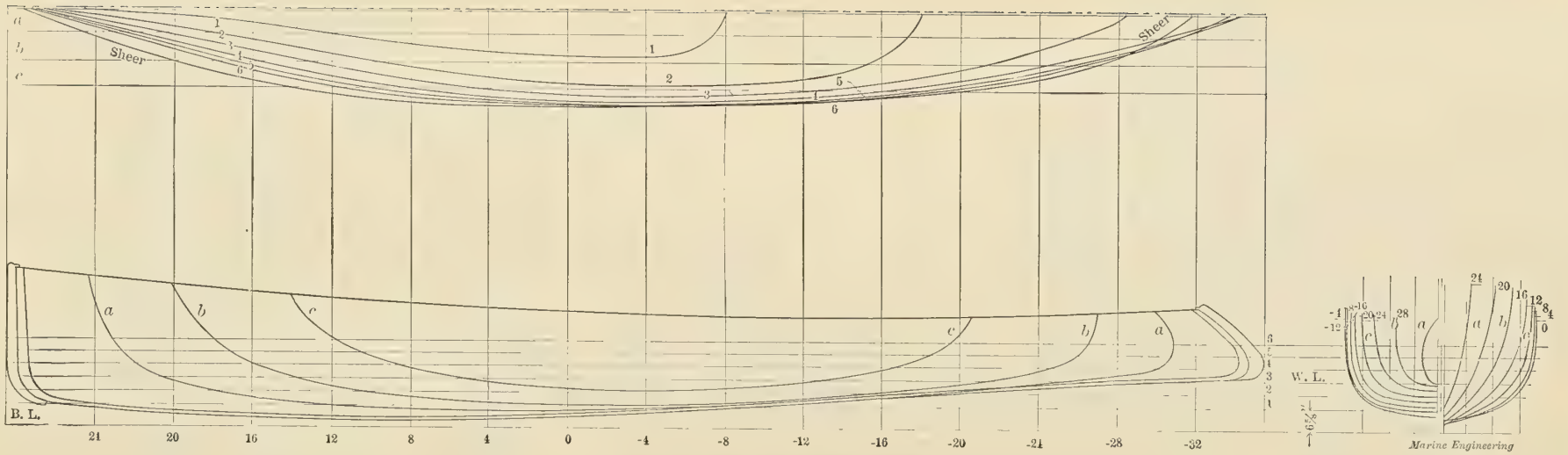
BARK GIFFORD, WRECKED NEAR GOLDEN GATE, SAN FRANCISCO.

For wooden construction there are a number of firms building boats here on the bay. However, small boat building, especially that of yachts, is almost in its infancy. San Francisco bay makes an admirable cruising place for yachts, as it is a large inland body of water and there is generally a good breeze blowing the year round—the trade winds. The climate is such that it is not necessary to lay a boat up in the winter months, which should surely be an inducement to yachtsmen. There are in all eight small wooden boat builders on the San Francisco side of the bay, six across at Oakland, two at Sausilito, and one at Tiburon. All of these build



VIEWS ALONG THE WATER FRONT OF SAN FRANCISCO HARBOR.

1. Wreck of Steamer *Progresso*.
2. Landing for Italian fishermen.
3. Unfinished bow of cruiser *Milwaukee*.
4 Product of United States Dredging Company.
5. Working on steel vessel at the United Engineers' Works for the Alaska Packing Company.
6. Fitting new outer bottom forward on passenger steamer *Monticello*, Hay and Wright's shipyard.
7. Wooden steam schooner under construction at Frank Story's yard.



LINES OF 32-FOOT SPEED LAUNCH EUSONIA.

small boats of every description and carry on general repair business. One of the builders is an Italian, who terms himself the "Oceanic Boat Builder," and caters almost entirely to the Italian fishermen, of whom there are a great number on the bay.

It is a very beautiful sight, indeed, to see a fleet of these fishing boats coming in through the Golden Gate, their sails tanned a dark reddish-brown, and, in fact, the boat and rig being that of a typical Italian fisherman. The meeting place at the landing is one of the sights of the city. It is interesting to note that these Italians are of late finding out that a fishing boat equipped with a gasoline engine has a great advantage over the sail-propelled craft, as much time may be saved with it in handling nets and catches. The Italian is not slow in adopting this new form of propulsion, and soon we may expect his picturesque sail boat to become a thing of the past. Gas engines are being quite generally used in other than fishing boats, and the three makes made on this coast are very generally used.

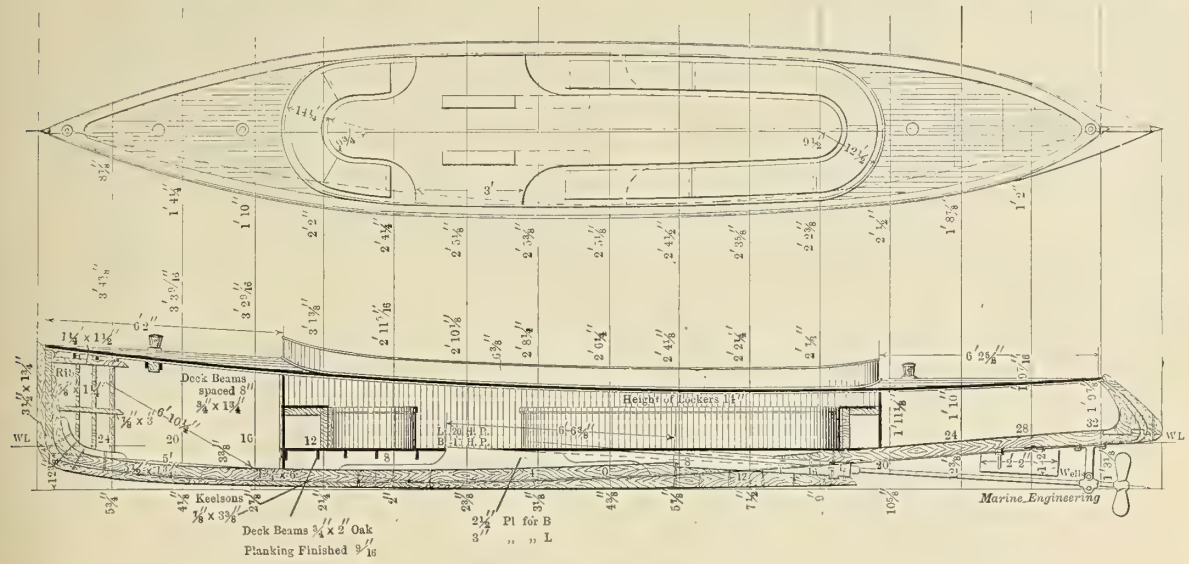
While the wooden boat builders have a little work on hand they all report work as being dull. There are five yacht clubs in and about San Francisco, one at San José, and one at Vallejo. These make up the list of yacht clubs in the state, and by going over the boats registered in them one finds that they are not of a size or class sufficient to furnish much new work for a boat builder. A large dredging company has of late started in to build its own dredges and barges.

As a whole the facilities here for handling any class of ship work are very good, with the notable exception that there is no first-class wrecking company. There would be much work for such a concern on this long and rocky coast, and many a ship might be ultimately saved if a well-equipped wrecking company were at hand to salve her. The wreck of the bark *Gifford* is an example of what might be done on this coast by such a company; the *Gifford* was abandoned after a slight attempt was made to float her.

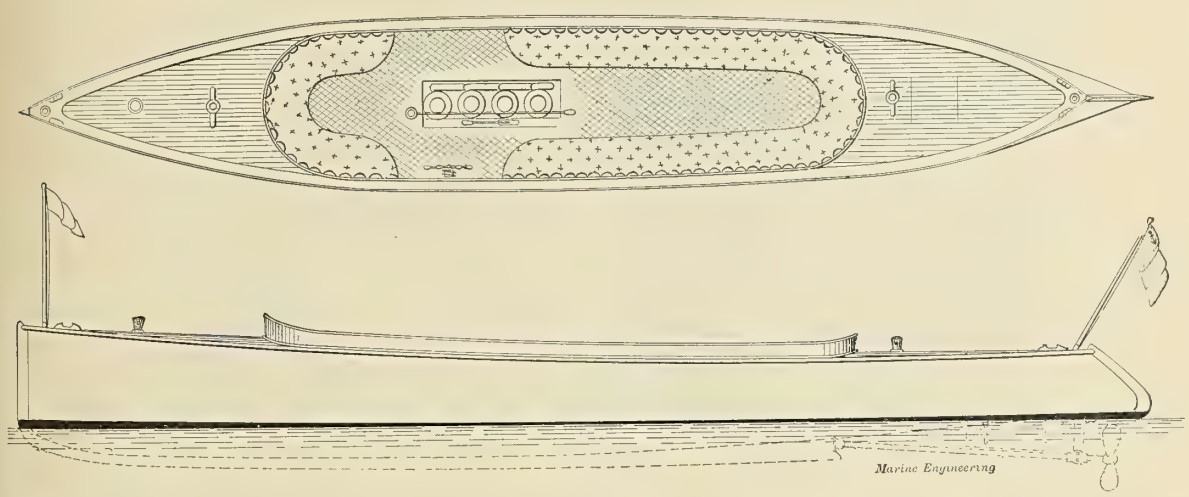
32-Foot Speed Launch Eusonia.

An incident which further attests the lead of the American launch builder is shown in placing the order for the speed launch *Eusonia,* for Felix Fournier, of Paris, France, with the Matthews Boat Company, of Bascom, Ohio. The boat is to be used during the coming season in the races of the Association Canots de France. The accompanying drawings clearly show the lines, construction, and appearance of this craft. She is 32 feet over all, yet her water-line length is but 29 feet 11 inches, which will bring her within the 30-foot class. When the boat is in motion she will, of course, have advantage of her greater overhang length. As is seen from the lines full buttocks are carried well aft, making her a roomy craft. The deepest part of the hull is forward of the engine, the keel gradually rising in an almost flat curve until it strikes the water line aft.

The keel, stem, and frames are of white oak, the latter of 5-8 by 1 1-2 inch. The details of construction of the keel, stem, and stern are shown in drawing on

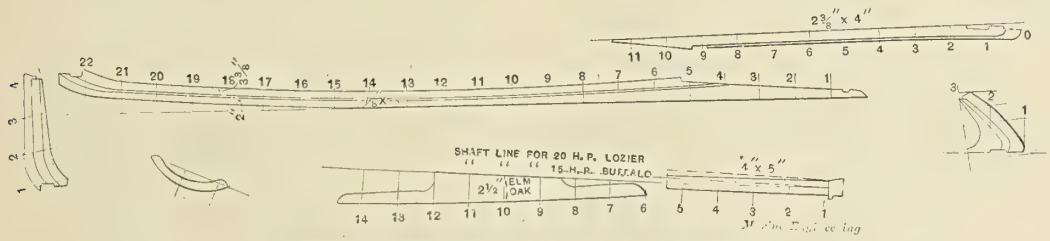


INBOARD PROFILE AND DECK PLAN.



GENERAL ARRANGEMENT AND OUTBOARD PROFILE 32-FOOT SPEED LAUNCH EUSONIA, BUILT BY MATTHEWS BOAT COMPANY FOR EXPORT.

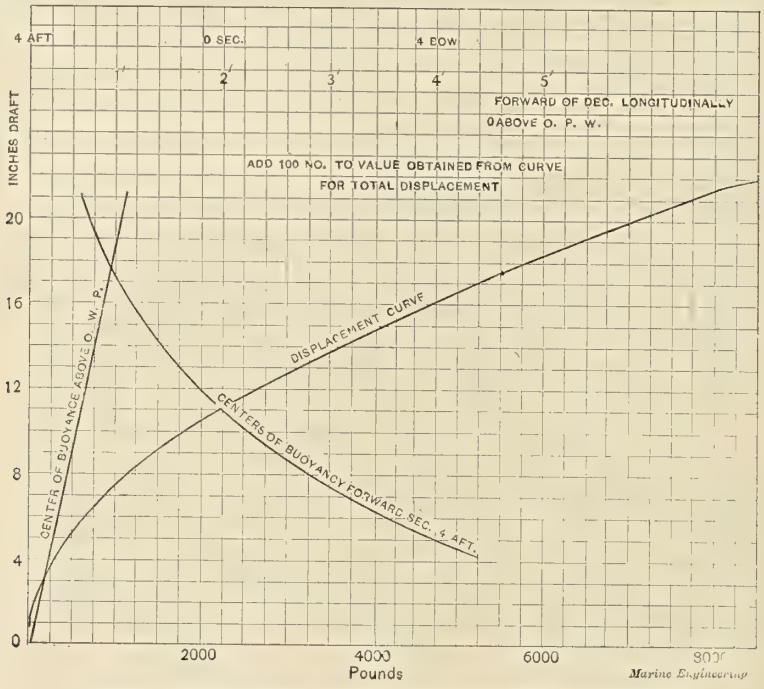
this page. The members are securely held together, and with the deep floors the boat will be of strong construction. The planking is 9-16 inch copper fastened throughout. The deck and plank shear are of 1-2 inch mahogany, and the combing is of quartered oak 7-16 by 6 1-2 inches at the ends. The cockpit is staved in 3-8 inch mahogany brass fastened, and the floor is of 5-8 inch white pine with brass screws and covered with linoleum. Lockers are placed under all the seats in the cockpit. The polished brass steering wheel is placed amidships, and a bronze chain cable connects with the tiller; the rudder is partially balanced, 2 feet 2 inches long, placed forward of the propeller, and is of Tobin bronze plate.



DETAILS OF STEM, KEEL, AND STERN OF THE EUSONIA.

The outfit and trimmings are as follows: two pairs of polished brass chocks, two oak towing posts, two flagpoles with brass sockets, polished brass stem and stern bands, and a spray hood. There are also polished brass hatch lift and boat hook, fenders, and mooring lights. The hull is painted with two coats of copper paint below the water line, four coats of white above the water line, and one of enamelette. Decks and interior, four coats spar varnish.

The boat is driven by a 25-horse-power, 4-cycle Lozier, 4-cylinder engine, fitted with reversing clutch, and all parts made as light as possible. The fittings are of brass for salt-water service. Because of the form of the stern, as above noted, it will be possible to apply a high power without causing the stern to settle. Also the strong construction will prevent undue vibration.



CURVES OF DISPLACEMENT AND BUOYANCY FOR SPEED LAUNCH EUSONIA.

light construction as consistent with necessary strength. There are two high-pressure engines driving the stern wheel; the cylinders are 9 inches diameter by 48 inches stroke. The principal parts of the machinery are of semi-steel. The boiler is a 36-inch locomotive type firebox, carrying a steam pressure of 200 pounds. The engines and boiler were built by the Willamette Iron and Steel Works of Portland. The boat, which is operated by the Northern Commercial Company of San Francisco, has now been in service for two years, and it is stated that no parts of hull and machinery have shown signs of weakness.

During the first year of her service, which, of course, was limited to a short Alaskan season of 77 days, she traveled 10,000 miles, against as swift and shallow water as has ever been navigated in any part of the globe, and this, too, under load conditions varying from 30 to 70 tons. She has just concluded her second year's experience under the same conditions, having gone a distance of 12,000 miles, and although subjected to much hard usage, she has been demonstrated a complete success.

The illustration is from a photograph taken of the steamer just after her initial plunge into the waters of Fifty Mile, at White Horse, Yukon Territory. The top of the dark water line is 12 inches above the lowest portion of the hull, her draft at that time being 9 1-2 inches aft and 6 inches forward. With steam up, and four tons of fuel, all equipment, furniture and stores on board, her draft was 10 inches aft and 8 inches forward. She took on at White Horse stores for three months and freight amounting to 55 tons weight, and with a draft of 18 inches even keel, proceeded without any preliminary trial on her maiden voyage of 2,000 miles to the town of Bittles, Alaska, above the Arctic circle, where she was in continuous service during the season of 1902. During this season, the lowest water ever known

Light-Draft Steamer for an Alaskan River.

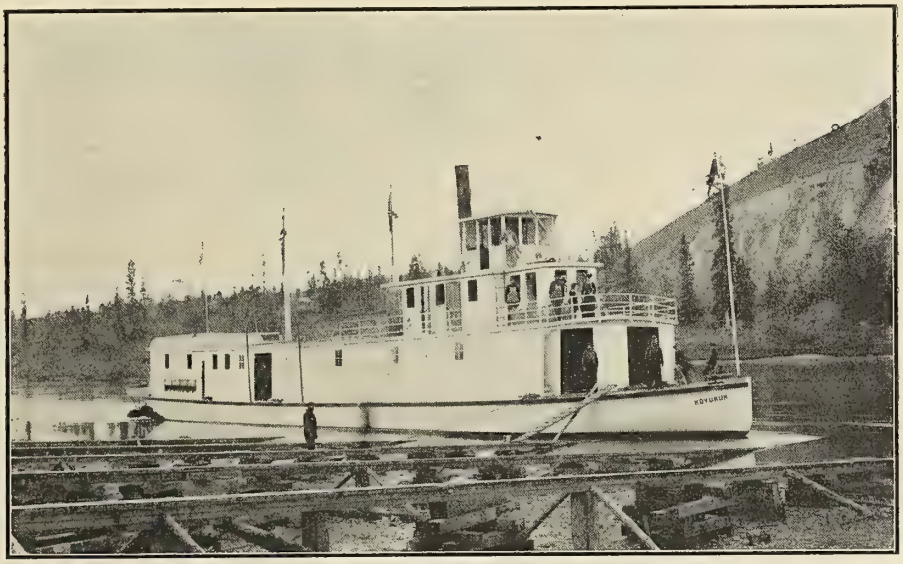
A boat here illustrated, and for service on the Koyukuk river, possesses some special features of construction which, it is stated, are entirely novel. The river is full of rapids and shallow water, and is extremely difficult of navigation by any ordinary craft. So it was decided, on building the *Koyukuk,* to construct a hull with a certain amount of flexibility to overcome the danger of straining, resulting from the almost certain grounding attending navigation in these shallow waters. Lightness of construction was another prominent feature, and it is claimed that this boat is the lightest draft serviceable steamer of the size ever built. She is 120 feet long, 24 feet beam, 4 feet molded depth, and the load draft is but 18 inches. The hull, which was built by Joseph Supple, was erected first at the shipyard in Portland, Oregon, then "knocked down" and shipped to White Horse, Yukon Territory, where the parts were again assembled, and the vessel launched.

In the machinery of this boat the design called for as

prevailed, the Koyukuk river being from 2 1-2 to 3 feet lower than any previously observed stage.

As before noted, she carried from 30 to 70 tons each trip, taking 30 tons up stream against swift water of 16 inches depth. At one place, known as Crimmins riffle and Gold Star bar, the fall is 25 feet in 3 miles. The *Koyukuk* ascended this heavy grade with 60 tons of freight, without landing at any point. At other times she has been blown out of her course and saddle-backed across the head of bars which only had 6 inches of water over them, and has even passed completely over them broadside, backing up the gravel on the lower side until it was over 4 feet high.

One of the most satisfactory results of the building of this craft was the restoration of confidence of the miners of the Koyukuk district in the ability of the transportation company to keep up the supply of food, clothing and machinery, which had been dangerously uncertain until the advent of this steamer.



LIGHT-DRAFT STEAMER LAUNCHED ON THE KOYUKUK RIVER, ALASKA.

The Laying Up and Storing of Small Yachts for Winter.

BY FREDERIC S. NOCK.

The laying up and storing of yachts for the winter months involves more than is generally supposed by the average owner. Where a crew of one or more are kept the captain usually looks after a number of the necessary details, but to the small yacht owner in general it is a case of leaving the boat with some builder, and he then thinks little or nothing about her until the weather begins to get warm again, when he gives orders to have his boat put in commission. He probably is not aware of half that has to be done to her in order to keep her in proper condition for the winter—how she is hauled out or laid up. Many people imagine that a small boat has to be hauled out on the marine railway just as if the boat was to be cleaned and painted, and I have often been asked, "How do you get them off the cradle and put them where they are?"

There are a number of ways of hauling out boats, but undoubtedly the simplest method, especially where the boat is of shallow draft with keel the full length, as in the old type, is to haul it up on rollers. This method is not so convenient when it comes to hauling out a boat of modern type with a keel of from four to eight feet in length on the foot and of a draft of six feet or more. Then some builders use a carriage with uprights on each side that can be removed; on the top of this carriage is fastened a smaller cradle made of spruce joist running fore and aft with the ends slightly rounded, similar to the runners of a sled. Securely fastened to these fore-and-aft pieces are heavy cross timbers whose dimensions depend upon the weight of the boat which they are to sustain. The large carriage, with the small carriage or cradle secured to it, is run down the inclined track, thus submerging the cradle. The boat is then floated into position directly over and amidship of the cradle, being guided by uprights or some suitable mark; then the craft is guyed up and secured fore and aft with lines. The main carriage is now hauled up the track which brings the boat out of water. She is now shored and braced to the small cradle and then slid with the cradle from the carriage. This cradle is kept under the boat until the boat is again launched.

Another and practically the same method of hauling these keel boats is to ballast down in position at low tide a suitable carriage, either made up as aforementioned or as follows: Heavy timbers are laid crosswise and held together by two lengthwise strips on top and four on the bottom; two of the bottom strips are placed near the outside ends of the cross pieces and about twelve inches on each side is fastened another strip; these are to be used as guides to keep the carriage on the stationary track or skids. At high tide the boat is floated into position and made fast, and as the tide leaves her she rests in the cradle; then she is shored as in the aforementioned method and hauled to the desired place. Some builders prefer this method as there is less friction on the underside than there would be if the pieces the full length of the carriage rested upon the greased wood track or skids. Where the stationary track ends it is customary to use pieces of spruce planed smooth and kept well greased to move around to any desired place. A very

heavy craft is sometimes left on the last two skids, otherwise she is raised a trifle and the skids taken out from under the carriage, which latter should be left in such a position that the boat rests on the same level as she would float; this insures the proper drawing off of any water that might accumulate in the cockpit as it would run through the scuppers instead of settling at the opposite end and freezing up solid, as happens only too often.

One well-known firm of yacht builders has a very good method of hauling, which is nothing more or less than a system of tracks through the yard connected to the railway tracks. A boat is drawn out on a cradle resting on a carriage equipped with flanged wheels and the carriage, cradle, and boat hauled to some convenient spot in the yard and left until launched in the spring. While this is a good system it is very expensive.

When the boat is properly shored up the next thing to do is to unbend the sails; they should be thoroughly dried and stored in a dry place. When stripping the rigging care should be taken that all the parts are clearly marked where they belong. The spars should also be stored away where they will be protected from the weather. As to the mast: this on large boats is seldom taken out, but among the smaller craft the custom is to take it out. When left standing the mast should be well protected by a good coat of varnish, a coat of white lead, or ochre and lard, or, again, some masts are carefully wrapped with canvas.

The inside of the craft demands attention, for after the fittings and furnishings are taken out all the plumbing, tanks, waterclosets, and lavatories should be carefully inspected and the water drawn from same in order to prevent freezing. The plugs should be drawn out of the hull. It is an excellent plan to thoroughly clean out all the dirt and mud that has congregated around the heels of the frames and floors and clean and thoroughly rinse out the timbers. If a hose is handy it greatly facilitates matters, and the boat is then sweet and clean, instead of being chocked up with pieces of frozen mud.

Should the boat have decks, and other exterior woodwork finished bright, it may be necessary to give them a coat of good spar coating before she is covered up, though the condition of the varnish work at the time she was laid up would show whether this was necessary or not.

A piece of scantling should be set up amidship to form a ridge pole and over this the canvas for covering should be stretched, care being taken to have sufficient pitch on the sides to shed the rain and snow. One essential thing that is overlooked by many is the necessity of having a circulation of air through the boat in order to prevent sweating which will otherwise occur. The forward ports or hatch should be open, and where it is possible there should be a circulation of air under the cockpit and after deck; it is also a good plan to leave all locker doors or lids partially open, and if any of the locker doors are fitted with mirrors they should be removed and placed in a dry place.

The same suggestions apply to the laying up of gasoline launches as well as sailing craft; all water should be drawn off from the cylinder jackets and out of the pipes; all fittings liable to rust should have a good coat of cosmoline or a similar substance, and the inside of the cylinders should be given a coating of heavy oil. This oil is easily gotten rid of when desired by putting in each cylinder a small quantity of kerosene. Spark coils, sparking dynamos, or magnetos, should be disconnected and stored in a dry place. If common dry batteries are used the probability is that at the end of the season they are of little or no use; if the batteries are of the Edison-Lalande type it is well to pour out the potash and thoroughly clean them, and if the zinc and copper oxide are in good condition a fresh charge of potash with a few ounces of paraffine oil on top of same is all that would be needed in order to put them in good condition again.

Where the craft hauled out is equipped with a steam engine the engineer usually looks after all that is necessary to do in order to leave the machinery and boilers in proper condition for the winter. Most of the large craft are kept in the water all winter, and in some cases the owners of small craft prefer to have their boats laid up in that manner. It is then necessary to close the sea cocks, and, unless the boat in question is some large yacht that is to be kept warm all the season, to draw off the water.

Where a boat is fitted with a water-tight or self-bailing cockpit some provision must be made to prevent the scupper pipes from freezing; this can be done by putting a piece of rope through the pipe and leaving it there in such a manner that it cannot pass out of the pipe. Where the scuppers are very large a piece of rubber hose pipe carefully plugged is inserted in the pipes, and then if there is any tendency for the water in the pipes to freeze the pressure formed thereby exerts its energy upon the hose pipe. Among the large yachts it is customary to cover them in with boards, and in many cases they are housed in with a substantial wooden structure.

These particulars are intended for yachts of wooden or composite construction, yet where a yacht is built of steel or iron the only material difference would be that the metal work should be well protected with paint and no bare places left for the weather to rust.

Sectional Boat for the United States Army Transports.

There has just been completed for the United States Army transport service a boat of novel construction, built on the sectional plan. In order to expedite the landing or embarkation of men and munitions in our insular possessions it has been found necessary to have a larger tender than that which can ordinarily be carried on the davits of transports, and therefore there was undertaken a new type of sectional boat to meet the special requirements. Many sectional boats have already been constructed, and some of large size, but in this case it was necessary to have a boat that could be very quickly assembled away from a shipyard, and the assembling must be done at times in a heavy sea and after the sections had been separately launched from the transport.

The War Department issued a call for bids, stipulating the requirements, and leaving it with the bidders or builders to make their own plans and specifications. The proposal from the Gas Engine and Power Company

and Charles L. Seabury and Company, Consolidated, at Morris Heights, was accepted. The boat built, named the *Pontonier,* is seen in the accompanying half-tones.

There were some special perplexing features which are not evident at first thought. The different members or sections, each of different weight and size, and different weight of equipment, would naturally have different displacement and trim when afloat, yet they must be brought to a common water line before attaching to each other; each must have sufficient strength and buoyancy

The bow section is comparatively short, carrying derrick and the anchor equipment, with chain and store lockers inside. The quarter section, or that next the bow section, serves both as a hold for the cargo and as quarters for the crew—in fact, will berth twenty men if required. The third section carries a Seabury water-tube boiler, the coal bunkers, and a portion of the water storage. Her coal capacity will be 13 tons, giving her a liberal running radius. On the top of this third section is also fitted a pilot house, which is portable, with or

SECTIONAL BOAT PONTONIER, BUILT FOR THE UNITED STATES ARMY TRANSPORT SERVICE.

to float when in the sea before assembling, and must be so fitted as to permit of quickly assembling in rough weather. The general dimensions of this boat are as follows: length over all, 80 feet; beam, 18 feet; draft, loaded, 3 feet 6 inches; corresponding displacement, 72 tons.

The light draft is essential as the boat will be used for embarking and disembarking men, munitions, etc., in shallow waters. She is of steel construction throughout with angle frames and stringers, girder or plate keel and keelsons inside, and plating of 1-4-inch ship steel with lap-joints. With the steel deck each member becomes water-tight or box-like in form.

without which the vessel may be operated. The section next aft the boiler, or fourth section, will carry the driving power intact, consisting of two compound engines, which have 6- and 12-inch by 9-inch cylinders, their shafts, and the propellers, thus keeping them in perfect alignment and without danger of being disturbed. A portion of this section, measuring 11 feet 6 inches fore and aft, is cut off with an inside bulkhead to give quarters for the officers. The fifth section composes the oval counter which may or may not be used. As this section comes above the water line its omission gives the vessel a square stern effect.

In assembling the vessel the boiler section is first

floated, for as it has the greatest weight it establishes the water line; then the others follow in order, working either fore or aft. They are fitted with sea valves and sea water is admitted into their bottoms until they reach the common water line. Two sections coming together have their ends fitted with cones of about 14 inches diameter, one set pointing inward, the opposite pointing outward. On the deck of each section is fitted a small windlass with a steel cable which works on a differential system. The cable connects cones of one section to those of the other, and the windlass being operated brings the four cones together, one from each section engaging that of the one adjoining. When all have been secured the water ballast is removed by steam syphon

ELECTRICITY ON SHIPBOARD.—IV.

J. W. KELLOGG.

As an example of an electric installation on shipboard that would be practicable at the present time, let us assume a steamer about 350 feet long, 40 feet beam. with freight and passenger accommodations. Longitudinal section and plans of this steamer are shown in the drawing on page 75.

There would be installed 400 incandescent lamps, one searchlight, three cargo winches, two capstans, one anchor windlass, steering gear, and four ventilating fans operated electrically. Four 30-Kw. 125-volt generators, directly connected to four vertical tandem compound engines, would supply current to this equipment.

ASSEMBLING SECTIONAL BOAT PONTONIER.

connection and they are reinforced by connecting bolts, one section to the other. The boat is now ready for use as soon as the steam connection between the engine and boiler sections can be coupled and the piping for the feed water connected to the pumps.

When required to be taken apart for reloading on a transport, the operation is simple, involving only the breaking of the steam pipe and feed-water connections, removing the bulkhead stay bolts, and relaxing the cables holding the cones. To demonstrate that the parts could be quickly assembled or taken apart, a trial was made at the works of the builders. The vessel was built on ways, as is usual, and launched; then the sections were disconnected, as shown in the engraving, and quickly reassembled, the demonstration being satisfactory to the government officials. The *Pontonier* has been sent to Washington where she will be used temporarily for drilling until assigned to one of the transports.

The dynamo room is located on the plans just aft of the main engines on the platforms between decks. Current is distributed from a 12-circuit switchboard, on which provision is made for connecting the generators so as to obtain 125 and 250 volts; the lighting, windlass, and steering gear feeders to be 125 volts, and the winches, capstans, and ventilation fans to be operated on the three-wire system normally at 250 volts. It is intended to operate the windlass and steering gear from individual generating sets, which, when so used, will have no connection with the lighting or power system. The diagram of the switchboard connection is given on page 73.

Machines Nos. 1, 2, 3, and 4 are connected to four switches, A, A, A^1, A^1, which are double-pole, double-throw. When these are thrown down either 1 or 2 may be thrown on the windlass circuit, and 3 or 4 on the steering-gear circuit; when thrown up they distribute

current to four double-pole, double-throw switches, *B, C, D, E*. If these are all thrown in one direction the machines operate in parallel on the 2-wire system. If *B* and *C* are thrown up and *D* and *E* down, machines 1 and 2 operate on one side, and 3 and 4 on the other side of the 3-wire system; so that any combination of the machines can be made on the 2- and 3-wire system by means of switches *B, C, D,* and *E*, and the equalizer switches at the bottom of the diagram.

It is not expected that the winches will be in operation at the same time as the steering gear, and at no time in actual service would current be required for more than 50 per cent. of the total requirements of the plant with all apparatus operating under full-load conditions. It is probable that the ordinary requirements would be about 25 per cent. of the total.

While at sea two machines on the 3-wire system and one on the steering gear would be normally in operation

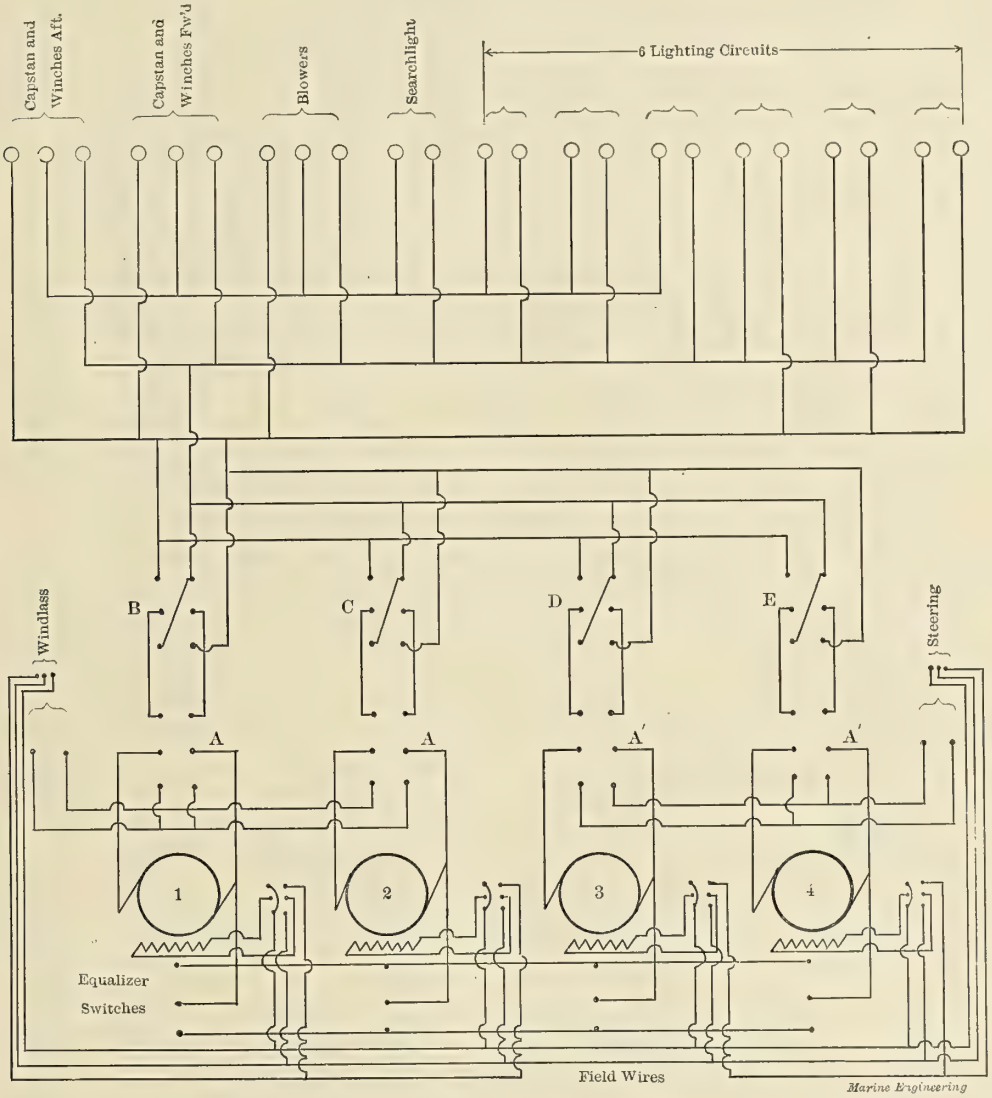


DIAGRAM OF WIRING FOR ELECTRIC LIGHTS AND MOTORS SUITABLE FOR SMALL STEAMSHIP.

The searchlight and three of the six lighting circuits are connected to the upper bus, the remaining three lighting circuits being connected to the lower set of bus bars. Three-wire circuits are used for the blowers, winches and capstans.

Three sets of field bus bars are provided, and double-pole, double-throw switches for each machine, so that one set of bars can be used for constant excitation of the field, and the other for the variable excitation which is required when the generator is running on the windlass or steering-gear circuit.

when lights were used. When ship was at dock two machines, and possibly four, would be connected to the 3-wire circuits.

The rated capacity of the four generators would be about 160 horse power, but they could be operated at 200 horse power under such conditions as would exist while the ship was loading or unloading at dock. The winches would require a maximum of about 75 horse power, the capstans, steering gear, and windlass each about 50 horse power, lighting, searchlight, and ventilation about 75 horse power.

The distribution of the lights would be as follows:

Shaft alley	9
Dynamo room	8
Engine room	20
Boiler room	8
Cargo spaces, five 4-light clusters	20
Fixed lights	20
Saloon, main deck	85
Forward, "	16
Aft quarters	30
Saloon, lower deck	59
Forward, "	20
Cargo	6
Outside, upper deck	25
Smoking room and state rooms	50
Wheel room, captain's and officers' quarters	18
Running lights	6

The main switchboard would be located in the dynamo room, and the twelve circuits arranged as follows:

SIX-LIGHTING CIRCUITS.

No. 1. Lower-deck quarters.
" 2. Engine and fire rooms and shaft alley.
" 3. Main-deck saloon.
" 4. Freight spaces and main deck aft.
" 5. Boat-deck quarters.
" 6. Running lights, deck lights, and fields of the motors operating on 250 volts.

OTHER SPECIAL CIRCUITS.

" 7. Searchlight.
" 8. Windlass.
" 9. Capstan and winches, aft (*C* and *B*).
" 10. Capstan and winches, forward (*B* and *D*).
" 11. Blowers.
" 12. Steering gear.

Circuit No. 1 would run from the dynamo room to a 10-circuit panel in the passageway in the state room spaces on the lower deck and divide, supplying light for the state rooms, passages, and crew's quarters on the main and lower decks; the saloon lighting requiring seven circuits, the forward compartments two, and the cargo one. This circuit would consist of 40,000 c.m. wire composed of nineteen No. 17 strands, and would be run from the switchboard in conduit through the bulkhead forward of boiler room, and from there in moulding to the panel board.

Circuit No. 2 would run from the switchboard to an 8-circuit panel board placed in the engine room just outside the dynamo room supplying current for one circuit for shaft alley, one for dynamo room, one for boiler room, three for engine room, and two for cargo. All would be run in iron pipes with steam-tight fixtures, the main wire being 21,000 c.m. of seven strands No. 15.

Circuit No. 3: From the dynamo room to the pantry, with a 15-circuit panel just aft of the stairs on the main deck; eleven circuits to the saloon, two for the cargo spaces, and two for crew's quarters forward. This would be 50,000 c.m., 37 strands of No. 18, and would be run in conduit from switchboard to panel board.

Circuit No. 4 would run from the dynamo room to the after quarters on the main deck in iron piping to a panel board with four circuits. The size of the main would be 6,530 c.m. cable, seven No. 19 wires.

Circuit No. 5 would run from the switchboard to the bulkhead just back of the main-saloon entrance on the upper deck to a panel with nine circuits; three for smoking room on upper deck, three for state rooms, and three outside. The main would be 26,250 c.m., nineteen No. 18 strands, run in iron conduit.

Circuit No. 6 would be of 6,530 c.m., seven No. 19, run in iron conduit from the dynamo room through the passage way in the house on the aft boat deck to a 4-circuit panel; three for officers' quarters and one for running lights.

Circuits Nos. 5 and *6* will each have an additional switch on the panel for field circuit for motors.

Circuit No. 7 would be of seven No. 19 stranded cable, running in conduit direct from the dynamo room to the searchlight.

Circuit No. 8, for the windlass, would run in conduit, and be of 500,000 c.m., with two field wires.

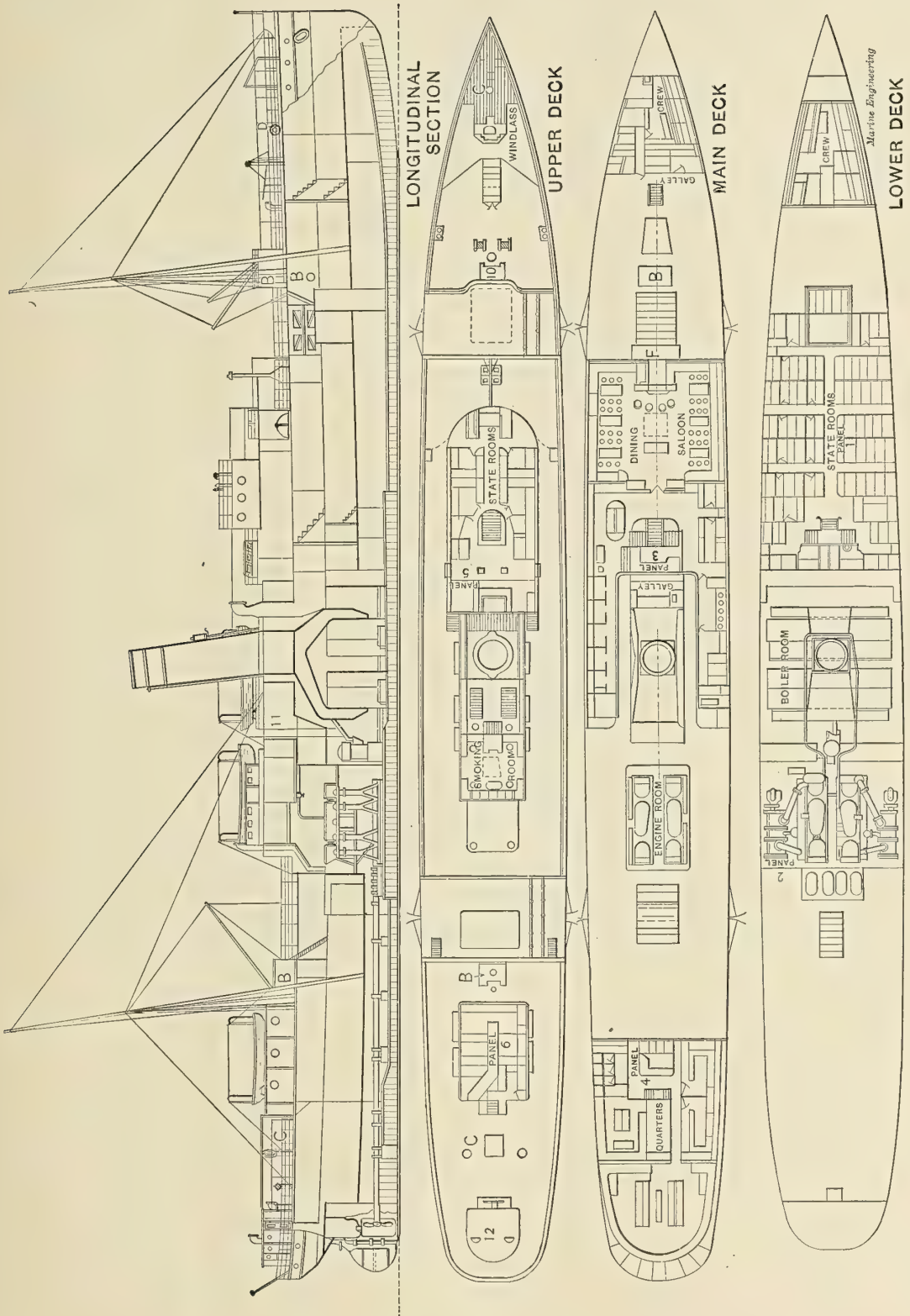
The method of operation of the windlass is as follows: The armature circuit of the windlass motor is connected with the armature of generator 1 or 2 by throwing down switch *A* and closing the windlass-circuit switch; the fields of the generator not being excited until the operator at the windlass is ready to start, at which time the fields are strengthened until the motor is up to speed. If thereafter any excessive strain is put upon the motor, by reason of the anchor holding, the capacity of the generating set is such as to make it impossible to overload the motor unduly. The speed of the engine will drop and lower the voltage of the generator, reducing the speed of the motor. If the strain is sufficient the motor will be stalled, and as the anchor releases, or the ship makes slack chain, the engine speed will pick up, raise the voltage of the generator, and speed up the motor until the load again becomes too great, when the motor will be again slowed down. The action is thus practically the same as on the present steam windlass, and is a perfectly safe and simple arrangement.

It would appear that the anchor gear is one of the first auxiliaries to which the electric motor should be applied, as the troubles incident to the connections of a steam windlass are many.

Circuits Nos. 9 and *10* would be each of 250,000 c.m., run in conduit direct to the controller for the machines. The motors would be enclosed, water-tight, with cylinder controllers of the street-car type.

For the winches it is generally sufficient to install a foot brake, but with electric motors, on account of the possibility of interruption of current in the circuit, it is desirable to have an automatic brake that will prevent the load from descending in case the current is cut off from the motor. There are several forms of these automatic brakes, the most common being a solenoid band brake that is held off as long as current is at the brushes of the motor.

Circuit No. 11, for ventilation, will be 200,000 c.m., run in conduit from the switchboard to the blower room on upper deck in spaces over the boilers. There are two steel-plate fans here, driven by shunt motors. Current is also distributed from here to two cast-shell fans, one for aft quarters and one for crew's quarters, forward. The air supply on the steel-plate fans is regulated by varying the speed of the motors from full speed to half-



PLANS OF SMALL OCEAN STEAMER, SHOWING ARRANGEMENT OF SWITCHBOARD PANELS.

speed, and also by field control of the motors between these two speeds.

Circuit No. 12: The steering gear is operated from a 500,000 c.m. circuit, running in conduit from the switchboard direct to the steering room on the upper deck at 12. Controlling circuits are run to pilot house and bridge.

FROM SEA COAST TO LAKES.

BY C. A. MCALLISTER, CHIEF ENGINEER, U. S. R. C. S.

In speaking of a trip from New York to Milwaukee, Wis., one would naturally associate with it a 30-hours' ride on a train, with the smoke, dust, and other annoyances or inconveniences incidental to a railroad trip of that length. Rarely does it occur that an opportunity is offered to make the passage between the two cities entirely by water; yet such an opportunity was afforded to the writer on the recent voyage of a small government vessel between the two places mentioned. To one not familiar with "a life on the ocean wave," on the great inland seas of North America, such a trip presents some rather novel features. The following notes and observations may, therefore, prove of interest to marine engineers and to seafarers in general.

The ship in question was constructed at a coast shipyard, and although primarily designed for service on the Great Lakes, is fitted with a surface condenser and other apparatus such as is customary for service on salt water. In general dimensions the vessel upon which this trip was made is 178 feet long over all, 30 feet beam, and has an extreme draft aft of 10 feet 6 inches. Her displacement was about 720 tons, and when her engines develop about 1,500 indicated horse power she can steam fourteen knots, but her usual cruising speed was from 11.5 to 12 knots.

The vessel left her anchorage off Tompkinsville, N. Y., late on the afternoon of September 10th, and passed up through the East river and Hell Gate into Long Island sound. The following morning we passed through Vineyard sound, and at one o'clock in the afternoon passed Pollock Rip lightship, from whence the course was laid for Cape Sable, Nova Scotia. At 9 o'clock on the morning of the 12th Cape Sable was abeam. From that time until noon the following day was spent in running along the coast of Nova Scotia, about ten miles off from the headlands.

Entering the Gut of Canso shortly after noon on Sunday we began the interesting part of the trip. This narrow strait—in some places it is less than half a mile in width—is bordered on each side by rich farming communities. One noticeable feature was the large number of neat white churches, apparently one-third of all the buildings in sight being places of worship. Port Hawkesbury, on the Nova Scotia side of the Gut, appeared to be the only town of any size, it being the place where the railroad trains were ferried to and from Cape Breton Island on an enormous ferryboat, which has the distinction of being fitted with four smoke stacks. The run through the Gut occupied about two hours, and the course was then laid up the Gulf of St. Lawrence.

The St. Lawrence river is supposed to join the Gulf at Gaspé Head, but just why the distinction is made at that point is difficult to imagine, as Anticosti island, the nearest land on the north side of the river, is about sixty miles away. We were abeam of this point at 8 o'clock on the morning of the 14th. Since leaving New York we had encountered weather conditions of the very finest, but as soon as we started up the river a fierce northwest gale set in, and as the tide was then making flood, a very nasty head sea was encountered. As but little headway could be made on account of the violent racing of the engine, we turned back and found a very smooth anchorage in Gaspé bay. Here some members of the crew, with Izaak Walton tendencies, soon caught a fine mess of rock cod. At the entrance to this bay we saw what is probably one of the smallest lightships in existence, as she was scarcely forty feet in length, and had been evidently a small sloop earlier in her career. In this connection it should be said that the Canadian government has been very liberal in its appropriations for aids to mariners, as all of the waters through which we passed were as well buoyed and lighted as American waters.

Early in the evening, the gale having moderated, we got under way and again started around Gaspé Head, this time finding the sea quite smooth. It was noon on the following day before the river had narrowed down sufficiently so that land could be sighted on both sides, and it was 8 o'clock on the next morning before we anchored in the river off Quebec. We were now in fresh water, and the trouble and annoyance of keeping salt water out of the boilers were at an end. Only those engineers who have had a regulation against the use of salt water in boilers to contend with, and who have been compelled to sound tanks and run an evaporator for the make-up feed at sea, can fully appreciate what a luxury it is to have an unlimited amount of fresh water to draw upon for boiler-feeding purposes.

We stopped at Quebec for an hour only, and with a new pilot were soon headed up the river again. We now had a steady head current of varying velocity to run against. In several places the river widens out, and such localities are graced with the title of lake. Notable among these is the Lac St. Pierre, through which we ran at about sundown. A passing wood scow called to mind the famous poem about the lamentable wreck of the Julie Plante when "The wind she blow on the Lac St. Pierre." At 11 in the evening we arrived opposite Montreal, and as the current is so swift along the river front, and the docking facilities very limited, we at once entered the Lachine canal, and passing through two locks, were lifted about 20 feet above the river level, where we found fine wharfage facilities in one of the slips branching off the canal, right in the heart of the city. We had now completed the first stage of our journey, having traveled a distance by log of 1,720 statute miles from New York city. As there are excellent facilities for coaling ship in Montreal, the coal bunkers were filled with American coal, which we were enabled to buy out of bond through the courtesy of the Canadian officials. The men employed in coaling were French-Canadians, who used small, bowl-shaped baskets, each only holding about a good-sized shovelful. Notwithstanding the diminutive size of the baskets, the coal was put in the bunkers very rapidly, and with an unusually small amount of dust and dirt.

Before entering upon a description of the remainder of the trip it will be well to state that Montreal is practically the head of natural navigation on the St. Lawrence, as the Lachine rapids end almost immediately opposite the city. From Montreal to Ogdensburg, N. Y., there are a series of rapids in the river which make navigation up the stream impossible, and down navigation extremely hazardous. To get safely around

these rapids the Canadian government has established a number of canals and locks so that safe passage in either direction can be had by using the river between the rapids and the canals around them.

The total distance between the two cities mentioned is 119 miles, of which practically 44 miles consists of canals. Naturally the smallest lock in the entire system determines the extreme size of vessel which can safely pass through; up to two years ago the smallest lock was the Morrisburg, No. 23, near Montreal. This lock was suitable for propellers 185 feet long, 25 to 30 feet beam, and drawing not over 9 feet of water. At the outbreak of the Spanish-American war, when the government decided to bring the Lake-built revenue cutters *Gresham, Onondaga,* and *Algonquin* to the sea coast, it was then necessary to cut them in two and pontoon the two sections all the way from Ogdensburg to Montreal, on account of this one small lock. At the present time the Beauharnois canal, in which the Morrisburg lock was situated, is not used, and a new canal, the Soulanges, with larger locks, has been constructed on the opposite side of the river. It is now possible for vessels 250 feet long, 42 feet beam, and 14 feet draft to travel safely throughout the entire system. These canals have generally a width of 100 feet at the bottom and 180 feet on the surface, and a depth of about 14 feet. Whereas there formerly was a canal toll of 2 1-4 cents per registered ton, the navigation is now free through all the Canadian canals and locks. Too much cannot be said in praise of the substantial manner in which the new canals and locks have been constructed. The locks are of granite and for the entire length of the new canal the sloping sides are built of stone. The lock gates are operated by electric motors and the entire length of the canal is thoroughly lighted by arc lights of 2,000-candle power each, about 150 yards apart, so that navigation by night is as safe as by day. The electricity is, of course, generated by water power from the rapids in the river. Everywhere we were impressed by the business-like way in which the locks were operated. We would steam right into the lock, make fast our lines, the lower gates would be swung silently shut, and the flood valves in the upper gate would be quickly opened. The lock would be filled in very quick time, four or five minutes being all that was necessary to lift us, in some cases, 20 feet, to the next level. There are altogether 21 locks between Montreal and Ogdensburg, and the total difference in level is about 222 feet. In the canals we were allowed to use our own steam, the speed being restricted to four miles an hour.

ST. LAWRENCE RIVER AND THE WATER FRONT OF THE CITY OF QUEBEC.

As the weather conditions were of the finest no pleasanter trip can be imagined than steaming slowly through the rich agricultural country traversed by the canals. As it was early autumn the orchards were laden with the choicest apples, peaches, and pears; in some places the trees would overhang the banks of the canal. Frequently the farmers would good-naturedly throw fruit aboard to the sailors, who, needlessly to remark, were willing recipients of such favors. Canadians are, as a rule, strict observers of the Sabbath,

and the canals are not operated on that day from 6 A.M. to 9 P.M., so as we had left Montreal on a Saturday morning we were obliged to tie up in the canal at the city of Cornwall over Sunday. The total steaming time from Montreal to Ogdensburg, a distance of 119 miles, was 20 1-2 hours, which, in view of the number of locks and the speed restrictions in the canal, shows the rapidity with which the locking was accomplished.

Arriving at Ogdensburg an opportunity was afforded for thoroughly cleaning the boilers. The river at this point is quite wide and the docking facilities excellent. We found the water so clear that objects on the bottom could be plainly seen at a depth of 20 feet. With this unlimited supply of pure, fresh water at hand, boiler cleaning was, as can be easily imagined, greatly facilitated.

On September 26, having completed overhauling the machinery, we left Ogdensburg at 9 A.M. and steamed up the St. Lawrence river. From here to Lake Ontario is probably the most picturesque part of the whole trip, as the course took us through the whole length of the famous Thousand islands. From the numerous little islets passed en route one can well imagine that there are at least, as the name indicates, a thousand or more of them. Opposite Alexandria bay, N. Y., nearly every one of them is inhabited, and the beautiful summer residences must be seen to be appreciated. One feature of these islands is the large number of what might be termed yacht barns, or storage places for the many pleasure craft. Some of them were large enough to safely house schooner-rigged steam yachts apparently 110 feet long, masts and all.

At Cape St. Vincent, which marks the end of the St. Lawrence river, we stopped a few moments to put the pilot ashore, and then steamed out on the first of the chain of fresh-water seas, Lake Ontario. Those of us who had never before cruised on the Great Lakes were interested to observe the conditions of the sea, etc. We were soon out of sight of land, but as the wind was light no unusual conditions of the sea were encountered, the waves being about of the same size as would be met with on Long Island sound. One of the first vessels we passed was of a type which is now fast disappearing on the lakes, a three-masted schooner. So far as model was concerned she was not unlike the coasting schooners, but her rig was strikingly different. Instead of all three masts being of the same height as on coast schooners they were of different lengths, apparently about the same as square-rigged sea-going vessels, the short mizzen mast being particularly noticeable. She carried one yard on the foremast upon which was bent a square foresail; above the yard was a triangular topsail, the apex of which was hauled up to the fore truck. Another peculiarity in this rig is that the foremast usually rakes forward, the mizzen mast aft, and the mainmast is about vertical. Only one or two steamers were passed on this run, as traffic is not very heavy, for there are no large cities located on Lake Ontario.

The trip from Cape Vincent to Port Dalhousie, at the northern end of the Welland canal, or nearly the whole length of this lake, was made in thirteen hours. As we arrived at the latter port very early on Sunday morning we were again obliged to tie up over the Sabbath owing to the canal regulations. We commenced our journey through the famous Welland canal at daylight Monday morning. Although this canal is only 26.7 miles long there are 26 locks through which vessels must pass, and the difference in the level between the lakes which it connects is 326 feet 9 inches. The locks are of a uniform size, 270 feet in length, 45 feet wide, and 14 feet depth of water over the sills. The country traversed by this canal is probably the richest fruit section in Canada, and as it is very hilly the views from the different levels are superb. About three miles from the summit we discerned a large seagoing steamer apparently cruising along the ridge, traveling through orchards and fields with the greatest ease. When we finally passed her we found that she was an English-built turret steamer hailing from Newcastle-on-Tyne. This passing of two seagoing vessels in an apple orchard on top of a ridge was an experience not met with on every trip by water.

We passed through this canal under our own steam, the speed restriction being four miles an hour. As the banks are lined with broken stone the slight wash from the propeller at this speed had no damaging effect. We arrived at Port Colburne, the Lake Erie end of the canal, after dark in the evening, the run having been accomplished in fourteen hours. We had now reached our level, so to speak, as Lakes Erie, Huron, and Michigan are practically the same height above the sea level, no locks intervening between them. Lake Superior is 24 feet above this level, and to attain this all vessels have to pass through either the American or Canadian lock built by the governments at Sault Ste. Marie.

The run from Port Colburne to Detroit, Mich., our next stopping place, was made in 18 hours, during which time we ran nearly the whole length of the lake. We could now get some idea of the vast amount of commerce on the Great Lakes, for passing Cleveland, Ohio, early in the morning, we met a procession of lake steamers and barges which seemed practically endless. In a four-hour watch no less than 28 steamers were passed going in the opposite direction. They varied in size from the 500-ton lumber steamer to immense ore-carrying steamers 7,000 to 8,000 tons capacity.

The typical lake steamer is, to one accustomed entirely to ocean-going craft, a novel sight. When they are hull down all that can be seen are two houses apparently some distance apart. Upon closer inspection it will be seen that this effect is due to the fact that the pilot house, bridge, etc., are built as far up in the eyes of the ship as it is possible to get them, and the machinery, deck house, and smokestack are just as far aft as possible, the intervening space having no superstructure of any kind, except a long row of hatches, which, of course, do not show above the rail. As the pilot house is so far forward it is naturally next to impossible to steer a straight course with no fixed object ahead to steer by. This is obviated by the use of jack staffs or steering poles, swung out ahead of the stem and in line with the center of the vessel. On the end of this jack staff there is usually a fancy arrow or spear head, round ball, or similar object to steer by. As an Irish fireman rather aptly expressed it, "They look like as if they were going out to fight aich other with spears."

Another object of interest when we came closer to some of the lake steamers was a large pile of coal just forward of the after deck house. Inquiry developed the fact that many vessels carry all their steaming coal on deck, and that it is simply shoveled down into the fire rooms as needed. A coal passer's job is, under such circumstances, much pleasanter than on vessels which carry coal in bunkers.

On our arrival at Detroit, Mich., where we stopped for two days, we had further opportunities to observe the immense size of lake traffic. Seemingly at all hours of the day and night there are vessels going either up or down the Detroit river. It is claimed by statisticians that more tonnage passes Detroit in one year than enters and leaves the ports of New York and Liverpool

TYPICAL THREE-MASTED SCHOONER ON THE GREAT LAKES.

combined. As the year's work on the lakes must be done in practically seven months, on account of the suspension of traffic during the winter season, some idea may be gained of the number of vessels which are constantly passing. For the accommodation of the passing fleet the government has established at this port a marine post office, which simply consists of a small steamer which either runs alongside of each passing vessel or sends a boat off to deliver and collect all mail matter, without necessitating even a slackening of the ship's speed.

Probably one-half of the steamers passing this point have a large barge, or "consort," as they are termed, in tow. Many of these barges are of the "whaleback" variety, a type not wholly unknown on the Atlantic. A noticeable feature on many of these steamers and barges is that they are fitted with hawse pipes and carry anchors at the stern as well as at the bow. As they are frequently compelled to anchor in narow channels on account of blockades and fogs, and as the current always runs in one direction, these stern anchors are great conveniences. The stockless anchors are universally used on all the vessels built within recent years.

While freight steamers compose probably 98 per cent. of all the vessel traffic on the Great Lakes there are quite a number of passenger vessels, and these are fully up to the standard of the best vessels engaged in the passenger traffic on the seaboard. The *North West* and *North Land* are, of course, very well known to people on the coast, but there are two new steamers engaged in the passenger business between Detroit and Buffalo, the *Eastern States* and *Western States,* which would attract attention anywhere. They are large side-wheelers, with compound inclined engines, and are capable of making 19 miles an hour in all kinds of weather. In equipment and general outfit they are the equal of anything that floats.

Speaking of the speed of these vessels reminds me that on the Great Lakes *knots,* or nautical miles, are unknown. All chart distances and all speeds are given in statute miles.

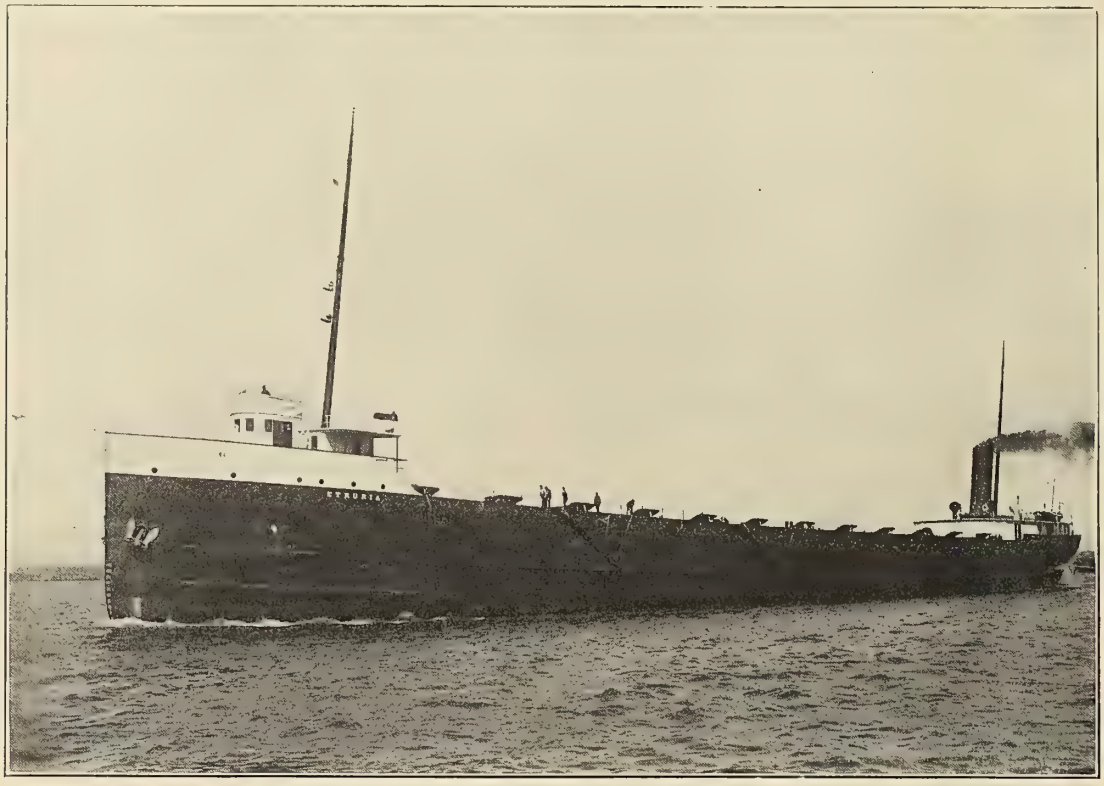
Another peculiarity of interest is the way they have of that on the Great Lakes *knots,* or nautical miles, are of these lake vessels. Instead of using bells, as are almost universally used elsewhere, they have a small, shrill whistle located in the boiler room or other place

THE WHALEBACK ORE CARRIER OF THE GREAT LAKES.

convenient to the engine room. The officer on the bridge simply pulls the whistle rope connected to this small whistle and the following system is adopted. One blast, go ahead; one blast, stop; two blasts, back; three blasts, check or slacken speed in either direction; when repeated, slack more; four short blasts, or one long blast, full speed in either direction. The same system is used for bells, except that the jingle is used for full speed. Fog signals are also somewhat different; instead of one long blast, as is customary on the coast, lake vessels employ three short blasts blown at intervals of one minute. This system enables approaching vessels to exchange passing signals, and in close quarters is found to work very satisfactorily.

We left Detroit for the final stretch of our journey at 7 o'clock on the morning of October 2, and steamed into and through Lake St. Clair, thence through St.

Clair river by Port Huron, and at 1 o'clock in the afternoon entered Lake Huron. The following morning we were treated to a fair sample of bad weather of the Lakes. Just before entering the Straits of Mackinaw we encountered a severe thunder shower which ushered in a gale of wind. The barometer fell very rapidly, at one time going as low as 28.68, which, had it occurred on the ocean, would have caused considerable consternation. However, when we considered our elevation of over 500 feet above the sea level, it did not seem so alarming. For the next twelve hours we experienced about all kinds of disagreeable weather on the catalogue. Coast sailors are apt to refer to what they term "Fresh-water sailors" in a slighting manner, but the writer can



STEAMER ETRURIA, A MODERN ORE CARRIER OF THE GREAT LAKES.

testify from observations gained in that gale, that the seas are fully as bad, even if they are a little shorter, and that just as much seamanship, if not more, is required to safely weather a gale on the Great Lakes as is required under like circumstances on either the Atlantic or Pacific oceans. The wind finally settled into a fresh breeze from the northwest, and the remainder of the run down Lake Michigan was without noteworthy incident. We anchored off Milwaukee, inside the breakwater, the following morning, having completed our journey.

The total distance logged was 2,998 miles, or practically the same length of voyage from New York to Liverpool, but under very different circumstances. While traveling this distance horizontally we had ascended to a height of 583 feet, as the difference in the level between New York bay and Lake Michigan is that amount.

While in Milwaukee an opportunity was had to inspect a modern lake freight steamer of 5,000 tons register which had just been completed. As illustrative of the rapidity of ship construction in Lake yards, it is interesting to note that this vessel was completed and her hold filled with her first cargo within five months from the day that her keel was laid. The engine room contained many interesting features, notably, to us, the jet condenser. To one wholly accustomed to surface condensers the idea of an apparatus about the size of two oil barrels stood on end, condensing all the steam from a 1,600 H. P. triple-expansion engine, seemed quite marvelous. In design, the main engine represented the very latest practice, but in finish it was the acme of simplicity. While everything was provided which would add to its economical operation, nothing was added for purely ornamental purposes. She was provided with two-furnace Scotch boilers and the Ellis and Eaves system of induced draft, which we were informed was very largely used on Lake vessels. For lubricating purposes grease, or "dope," as it is called here, was used everywhere about the engine except for the crank pins. As all large vessels on the Lakes are provided with double bottoms or ballast tanks, there was quite an elaborate system of piping for pumping out the various compartments, but everything else connected with the machinery outfit was as simple as it is possible to make it. One very good feature about the machinery was the gauge glasses for the boilers, which were so connected up that they were in plain sight in the upper engine room, so that the feed water could be regulated by the oiler on watch without his leaving the engine

room. The ship was provided with an electric-light plant and all the other up-to-date equipments of a first-class vessel.

One feature which would cause considerable envy among steamship officers on the coast was the large and luxuriously fitted quarters provided for the captain and chief engineer. An admiral of a fleet could have nothing better, so far as comfort is concerned.

It would interest deck officers of salt-water ships very much to see the masterly manner in which a 450-foot steamer is handled in a narrow thoroughfare such as the Milwaukee river. This stream is in many places less than 250 feet in width, yet one of these large steamers will start up to its dock, a mile or so up the river, as unconcernedly as if steaming out into the open lake. To add further to the difficulties of navigation there is a bridge about every 200 yards. Coming down the river the steamer will be towed the entire distance stern first, by two tugs, one at the stern and the other at the bow. As nearly all of the principal lake harbors consist of narrow rivers through the heart of the city this towing stern first is a very common thing, in fact so much so that many of the steamers are fitted with chain bridles at the bow and stern for the convenience of tug boats.

In conclusion the writer desires to state that many of the observations noted herein will, no doubt, seem very commonplace to those familiar with Lake navigation, but they are such as would, in his opinion, strike the average person brought up on the sea coast as being of interest on account of the contrast with similar conditions in ocean and coast navigation.

Congressional Aid in the Shipping Question.

Several shipping bills have been introduced in the present congress having as their object to relieve the depressing condition of our deep-sea shipping, yet it is probable that such legislation will be deferred until the report is received of the national committee recommended by President Roosevelt in his annual message. Following the president's plan a bill was introduced in the House of Representatives by Mr. Gardner, of Massachusetts, providing that such a commission be appointed. The bill is as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a commission is hereby created, to be called "The Merchant Marine Commission," to be composed as follows: the Secretary of the Navy, the Postmaster-General, the Secretary of Commerce and Labor, the chairman of the Committee on Commerce of the Senate, the chairman of the Committee on the Merchant Marine and Fisheries of the House of Representatives, three members of the Senate, to be appointed by the presiding officer thereof, and three members of the House of Representatives, to be appointed by the speaker: *Provided,* That at least two of the said members of the Senate and two of the said members of the House of Representatives shall be members of the minority party.

SEC. 2. That it shall be the duty of this commission to investigate and to report to the Congress at its next session what legislation is desirable for the development of the American merchant marine and American commerce, and incidentally for a national ocean-mail service of adequate auxiliary naval cruisers and naval reserves.

SEC. 3. That the commission shall give reasonable time for hearings, if deemed necessary, and if necessary it may appoint a subcommission or subcommissions of its own members to make investigation in any part of the United States, and it shall be allowed actual necessary expenses for the same. It shall have the authority to send for persons and papers and to administer oaths and affirmations. All necessary expenses, including clerks, stenographers, messengers, rent for place of meeting, and printing and stationery, shall be paid from any money in the treasury not otherwise appropriated; however, not to exceed fifty thousand dollars for expenditures under this section.

SEC. 4. That any vacancies occurring in the commission, by reason of death, disability, or from any other cause, shall be filled by appointment by the officer and in the same manner as was the member whose retirement from the commission creates the vacancy.

The bill was referred to the Committee on the Merchant Marine and Fisheries, and on January 14 a public hearing before the committee was given to a number of shipowners and shipbuilders.

Admiral Francis T. Bowles, now president of the Fore River Ship and Engine Company, stated that there was at present no chance for American shipyards to build steamers for the foreign trade; that their work was confined to ships for the Boston Steamship and the Boston Towboat Companies, said that representative merchants and public men would be actuated by no interest except that of patriotism, included on the commission.

Speaking for the shipowners, Alfred Windsor, president of the Boston Steamship and the Boston Towboat Companies, said that subsidies granted to foreign vessels had driven them off the Atlantic ocean and they had transferred their ships to the Pacific, only to find that there they must compete with Japanese and English subsidies. He did not mind losing money for a year or two, he said, to build up a business, but the situation had now come to such a point that the American ships would either have to go out of commission or be transferred to foreign flags.

C. B. Orcutt, president of the Newport News Shipbuilding Company, said: "If anything is to be done it must be done quickly. There are many more shipyards than the business warrants, and there are no contracts in sight. If you are going to allow the shipyards to go into the hands of receivers, when you want to build ships there will be no yards in which to construct them."

Edwin S. Cramp, vice-president of William Cramp and Sons Ship and Engine Building Company, urged that a commission be appointed. He termed the merchant marine a "kindergarten for the United States Navy."

A. R. Smith, superintendent of the Maritime Association of New York, said his association was unanimous for the adoption of the bill, and presented resolutions to this effect adopted by the directors. Americans, he said, can invest in foreign vessels and earn a fair return for their money; if investment is made in American ships there is no return. A subsidy by the government would operate to the benefit not only of owners of vessels, but to the advantage of laborers and mechanics in the shipyards, because vessels would be built to compete for the world's trade.

Samuel S. Sewall, of Bath, Me., spoke of the industry which had been handed down to him through his father from his grandfather. His family were the largest owners of American sailing vessels. "I don't expect to leave the business to my son," he said earnestly, "for as things are going now there will be no business to leave." His firm built its own ships, but a year ago it launched its last ship, which was for the coastwise trade. The yards were now shut down and there was no prospect of opening them, as the income from American ships amounted to about the same as that from government bonds.

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Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE recent address of the president of the American Society of Mechanical Engineers, as well as the not infrequent papers read before other engineering societies, dealing with educational subjects, show the deep interest which practical engineers feel in the matter of technical and engineering education. The time when the graduate of the technical school was without standing in the field of engineering practice is gone. Those who are in charge of the organization of industrial and engineering enterprises have found that the technical graduate is of definite economic value, and that the possibilities in the proper use of such a man are too great to be safely ignored. To gain the best results from such material, however, there must be a clear understanding of the true function of the technical school, and the graduates must not be expected to exhibit capacity and training which the school cannot be fairly called upon to give them, or at least the lack of such capacity or training should not be laid up against the school.

Broadly speaking, it is the function of the school to supply an opportunity, and to measure the extent to which the student avails himself thereof, certifying by a diploma to those who have, to a satisfactory degree, measured up the opportunities offered. The school cannot supply brains, or industry, or ambition, or other qualities essential to success, nor can it force the student to learn if he does not so choose. It should, however, and does, refuse to certify to the man in cases which fall below the standard assigned.

It is the further duty of the school in selecting among the wide range of activities which enter into the engineer's profession, to take those subjects which are fundamental and common to the profession at large, and, furthermore, to give primarily such instruction and training as the student cannot well obtain in the field of actual practice, or the attainment of which could only be achieved at the expense of a disproportionate effort. The possession of a diploma from a technical school means primarily, therefore, that the holder has had certain opportunities for becoming acquainted with the fundamental principles of engineering and with their application to various problems of a broad and representative character; and, furthermore, that he has availed himself satisfactorily of these opportunities and has therefore laid the foundation for success as an engineer. The latter, however, will require in addition years of experience with practical engineering and business life, contact with men and affairs, and a just balance of mind under control of good common sense. The recent graduate must not be assumed, by that fact alone, to be a man of affairs, a financier, a capable organizer and administrator of business ventures, a close estimator of production costs, an adept at handling labor and dealing with the many perplexing questions which the personnel of a large enterprise may involve, nor in general can he be safely assumed to have in an marked degree those qualities which are usually the results of actual experience with engineering and business life.

On the other hand, he may fairly be assumed to know how to do all sorts of things connected with the routine computations and determinations involved in engineering practice. He may be fairly assumed to know how to go to work to study new problems, and how to undertake to find out the unknown regarding questions which may arise in his daily work. The capacity for study, for grappling intelligently with the unknown, a capacity which every technical graduate should possess in some measure, is, perhaps, one of the most valuable

results which may be expected from technical training. In this same line the technical graduate may be fairly assumed to have capacity for studying new surroundings, for meeting new conditions, and for absorbing the essential features of new situations more rapidly and thoroughly than could be expected from the same individual without the advantages of such training.

In a general way most engineering work consists in determining the answers to two sets of questions: *what* and *how*—what shall be done and how shall we do it. As a rule the former questions require more of judgment and experience for their consideration, involving as they commonly do matters of policy and the weighing of opposing considerations, while in detail the latter questions more commonly involve simple engineering principles with a smaller element of experience and judgment. The latter elements are, for example, required in the determination of what combination of boilers, engines, and electric machinery will best fulfill the conditions for a given central-station power plant. Once the "what" is determined, the "how" of the design and installation is often a relatively simple and routine matter. While questions of the latter character often involve elements requiring broad experience and mature judgment, met in a general way, past experience can be more easily and directly applied to such problems, and the recent graduate can as a rule be more profitably employed in the early stages of his experience in connection with questions relating to the "how" rather than the "what."

The present status of the technical graduate shows that, in the opinion of those best fitted to know by direct use, the average man does gain in capacity for usefulness in engineering work by following a regular course of technical instruction, and any industrial undertaking in which the maximum possibilities of the present age are to be fully developed and utilized must recognize this fact. There may be exceptions to the broad rule. Some men might have their capacity for usefulness decreased rather than increased. Genius knows no law or limitation, and will assert itself quite independently of opportunities which the average man may well employ. The fact still remains, however, that the average individual, for whom courses of instruction have to be arranged, will profit by using opportunities which may be quite needless for the rare genius.

As to the reverse question—how well the technical schools are living up to their duties and opportunities—there is, perhaps, much to be said both in commendation and in kindly criticism. These remarks may, however, be reserved for a later opportunity.

COMPARISONS of American and foreign shipyards, which have regularly appeared in print for years past, have too often been inspired by a desire to belittle one or the other class of yards. This country long ago emerged from the experimental state in iron shipbuilding and established the fact that as fine ships can be built in this country as in foreign yards. However, it is always possible to improve, and by studying in detail the different elements which enter into the construction of ships, it will surely be possible to ascertain in what points construction may be cheapened. While this, of course, has been going on in all our shipyards and is the general manager's duty, yet we believe that much remains to be accomplished before our steel construction may be brought down to a cost comparable with other structural steel work. In busy times, getting out the work requires the attention of the entire force, while now in the dull present season the subject of economy may be more carefully considered. It is with this purpose in view that we have arranged for a series of articles on "Shipyard Economies," the second of which appears in the present number of Marine Engineering. With some notable exceptions, all of our plants are the growth of many years, and any conclusions as to where economies may be gained depend upon the lay-out of the plant as well as local conditions. Those elements, however, which are general to all plants are organization and labor. The difference in wages is responsible for most of the difference in cost between American- and foreign-built ships; the wages paid in our shipyards are practically the same, class for class, as elsewhere in the country; in the other iron manufacturing industries we have no trouble to compete with the foreign market; then why is it that in shipbuilding we cannot compete on the same lines? To anyone familiar with American yards, we will say that a large part of this is due to inefficient organization and administration. These questions in their different relations are dealt with in this article, the standpoint of the author being that of cheapening the cost wherever possible, without, of course, cutting down in any measure the output.

EVAPORATORS AND DISTILLERS.

BY G. W. BAIRD, CAPTAIN (FORMERLY CHIEF ENGINEER) U. S. N.

I have read with some interest an essay in your admirable journal under the above caption, by Mr. W. W. Edwards, and wish to state that the evaporator of the *Wilmington* is a No. 3 type B Baird machine; it is horizontal, with U-tubes, and unlike the (type C) machine shown in the illustration given by Mr. Edwards. It was not built by Mr. Davidson. The "distiller" he describes is also a Baird machine, though he does not name it.

My experiments in distilling from sea water began in 1862. The *Journal* of the Franklin Institute for January, 1872, gave a detailed illustrated paper upon the subject, clearly explaining the chemical and physical processes essential to the production of potable water by distillation from sea water.

The first so-called "distillers" on board ships having jet condensers, produced water which was potable after about a week's exposure in tanks. The same distillers, when used in ships having surface condensers, produced water which was not potable inside of two weeks. Such was the condition of our water-making when I took up the subject. Agitation of the water in the tanks, projecting the water in a spray, blowing air into the water in the tanks, and finally mixing air with the steam previous to its condensation, were tried *seriatim*. For the details of these experiments I beg to invite attention to the pages of the *Journal* of the Franklin Institute. The process which was the most effective, the quickest in its action, and the cheapest of mechanical construction was the mixing of the steam and air by means of the air injector known as the aërator, which I first patented in 1869. My evaporator, a fireless boiler, is a later invention. I made my first experiments on the evaporator in 1871, and took out my first patent in 1884. I had it ready for use as soon as the state of the art was ready to use it. The evaporator furnishes steam from sea water.

Sea water is essentially a chlorinated alkaline mineral water, the solid contents of which are chiefly sodic, calcic, magnesic, and potassic chlorides and alkalies, which, after distillation, remain behind as a residum and may be blown out of the boiler. The organic matter in sea water is limited.

The water in a steam boiler, especially when it is used in connection with a surface condenser, is very different. It contains great quantities of organic matter, which are uniformly accumulating all the time the engine is moving. The office of the aërator is to oxidize this offensive organic matter more than to give the water a sharp taste.

The aërator, however, is not nearly so effective unless used in connection with an animal charcoal filter—a filter which will not remove mud nearly so well as a quartz or a sand filter, but which arrests oxidized matter. This is why the Baird distiller was such a marked success in the period just preceding the evaporator, and if it was effective under such adverse circumstances, its use is warranted now. Mr. Edwards shows, in his Fig. 1, a Baird evaporator, distiller, filter, trap, etc., complete.

The taste of water freshly distilled from a steam boiler is oleaginous and "smoky," but from clean sea water, as used in an evaporator, it is only "smoky." A glass of water drawn from the distiller, when the aërator is in operation, will be so full of air that the bubbles will adhere to the sides of the glass as in a glass of soda water; the water is thus overcharged with air. The amount of oxidized matter precipitated and found in the bottom of the ship's tanks is an indication of the impurities which have come over from the boiler or evaporator. There are some volatile impurities in the sea water which come over with the steam, but these are exceptional. In the Bay of Callao the sea water is impregnated with sulphuretted hydrogen. In that bay we found it necessary to expel the gas from the water in a large boiler and draw upon this large boiler for the feed water for the distilling boiler.

Many years ago, before the days of using petroleum products for cylinder oil, the crew of the *Monocacy* was attacked with diarrhœa; not a man escaped. It was quickly traced to the potable water, which had been distilled from the main boilers while castor oil had been used in the steam cylinder of the main engine and had found its way into the boilers. There was not the slightest taste of castor oil in the water. The active principle of the castor oil seems, therefore, to be tasteless, and it is strange that chemists have not resorted to this simple method of separating it.

Freshly distilled water is, however, a strongly solvent fluid; it has never been known to injure an animal; it is an active agent in flushing out the kidneys, and will carry off impurities more rapidly that any other kind of water, excepting Poland water and some of the waters of Hot Springs, Arkansas. Both of these waters have the "smoky" taste peculiar to freshly distilled water, and probably much of it has been vaporized and condensed in the earth just previous to its exit. Freshly distilled water soon dissolves the zinc from the surface of galvanized iron; it rapidly eats "pit holes" into the purest Banca tin; it dissolves copper, hot or cold, to a greater extent than any other known water. But it seems to lose this active property with age.

The rapid destruction by distilled water is, I believe, responsible for much of the "pitting" of boiler tubes, the destruction of condenser tubes and shells, wrought-iron shells of feed heaters, etc.

If we place brass tubes in the brass shell of a condenser the tubes will corrode. If we place copper tubes in the same shell then the shell will go. If we place copper tubes in a copper shell the tubes will go. But if we use a cast-iron shell with brass tubes for a condenser or a feed heater, we may be sure of much greater endurance. Since learning this (from experience) I have never used any but cast-iron shells and brass tubes in my distillers, unless otherwise specified, and my experience in business, though limited, taught the futility of offering any extended advice to the men who make specifications.

The distiller has done much for the mariner and much for the shipbuilder. In the matter of weight alone a revolution has been wrought. A ton of coal will put from seven to eight tons of distilled water into a ship's tanks. The entire weight of the distilling

plant in the new ship is less than the empty tanks in one of the old sailing ships of the same displacements. Instead of carrying 150 days' supply of water a ship now has stowage for but 10 days' supply. Instead of an allowance of a gallon a day per capita there is now a liberal supply of water even for bathing. A bath tub was not known in a ship until steam and the distilling apparatus had come to stay.

It has done as much for hygiene. It is well known that a *change of water* frequently produces sickness. While a man may become immune to the typhoid bacteria, he is still susceptible to the *comma bacillus* which produces cholera. While he may be immune to yellow fever, he will readily respond to the active agents of zymotic diseases. The modern, educated physician now advises against taking a drink of water from a spring in the country; he advises his patient and his friend against any change of water excepting that which has been sterilized. It is safe to drink malt liquors (or water which has been boiled) when traveling. About twenty-five years ago epidemic Asiatic cholera appeared on board every ship in the harbor of Hong Kong excepting the United States war vessels, and on board these ships distilled water alone was drunk. Distilled water is the only water a sailor can get which is uniform in quality. Since its introduction in the navy diarrhœa and all other so-called zymotic diseases have diminished more than fifty per cent.

The great run of the battleship *Oregon* from Puget sound to Jupiter inlet, during the war with Spain, was greatly facilitated by the copious supply of fresh water for her boilers, which was "made up" by the Baird evaporators on board that fine vessel.

Editor MARINE ENGINEERING:

Referring to the criticism of Capt. G. W. Baird, U. S. N., of my article on "Evaporators and Distillers," I beg to advise that at no point in this article did I state that the *Wilmington's* evaporators were or were not Davidson machines. The blue prints and drawings, from which the illustrations Figs. 1 to 5 inclusive and Fig. 7 were made, were all furnished by the Davidson Company. In regard to the utility of the aërator I would state that my experience, extending over some years both in the navy and out of it, confirms my opinion that it is useless. I *know* that I have disconnected it and I *know* that no evil results came therefrom. The logic of fact is, to me, convincing.

WALTER W. EDWARDS.

Tenth Annual Sportsmen's Show.

The tenth annual Sportsmen's Show will be held at Madison Square Garden, New York, N. Y., from February 19 to March 5 inclusive. From present indications it promises to be most successful in point of artistic arrangement, number and class of exhibitors, and because of the interesting series of tournaments and exhibitions to be held. So great has been the demand for space that the frontage on the artificial lake has been given up entirely to marine exhibits. The tournament in fly casting has become so popular that a special tank has been built for this competition above the lake on a level with the galleries.

Typical exhibits will come from the wilds of Canada and the Rockies, and the hunting grounds of Maine, the Adirondacks, and Virginia. Various competitions will be held between the guides of the different sections, such as in saddling and off-saddling packing horses. A fine live-animal exhibit has been arranged for. The programme of water sports now being arranged will embrace canoe tilting, canoe racing, and several novelties such as push ball, which consists of canoeists endeavoring to push an immense floating leather ball 7 feet in diameter. It is promised that the marine exhibit will be specially interesting.

ENGINEERING SPECIALTIES.

New Boat-Launching Device.

While modern passenger steamers are being built of increasing dimension, and are fitted with innumerable auxiliaries in engine room and on deck for the efficient running and handling of a ship, comparatively little attention has been given to the arrangement for carrying lifeboats and adequate devices for launching them. The modern lifeboat with air tanks, cork fenders, and self-bailing apparatus, is all that can be desired as a life-saving appliance if it could but be successfully launched. The lifeboat is set in a cradle secured by lashings or grips and covered over by a canvas, all of which means that valuable time is lost when it becomes necessary to put the boat overboard; also if the ship has a bad list, as the result of an accident, one-half of the boats on the upside are made useless.

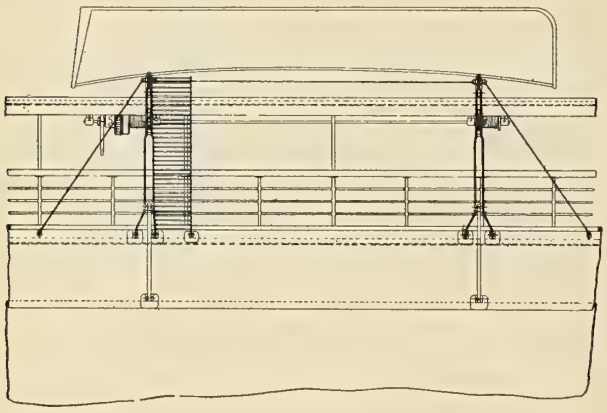
The Powers system of carrying and launching lifeboats is designed to successfully meet these severe requirements, and is adapted to existing types of ships and boats.

In this device the launching apparatus proper consists of a standing part, and a rocking arm, which, in the stowed position, extend inboard from the ship's side; this arm forming the support for the boat, which is carried bottom up on top of it. In this position the boat is inside the line of the ship's side, and, being on top of the davits, is to all intents and purposes outside them.

The boats when stowed are held in place by lugs on the rocking arm, which fit inside the gunwales; also by the hoisting lines wound on the drums. It will be noticed that these lines are led over the sheaves in such a way as to first bind the boat to the rocking arm, then bind the rocking arm to the standing part, and lastly, bind the standing part firmly against the ship's side. In this manner the boats are more securely held in place than at present, and the lashings are reduced to the minimum. By carrying the boats upside down, there are no covers to be removed; by holding the boats in place with the hoisting lines, all lashings are dispensed with, and by carrying the boats on top of the rocking arm no chocks are required.

The motive force used to operate this device is electricity. An electric motor, located in a convenient place, is connected by gearing to a worm shaft, which engages a worm gear, mounted loosely upon a long shaft located under the shade deck. This worm gear is arranged to be connected with this shaft by a clutch when desired.

Upon this shaft are two drums; one opposite each davit, upon which the hoisting lines are wound. Directly opposite each davit, on the under side of the deck, is a rack, driven by gearing connected to the main shaft at the side of each drum. These gears are so proportioned to the circumference of the drum and the position of the rack that the rack is forced to move at relatively the same speed as the lines upon the drums. It will be seen then that when the current is turned on in the proper direction that the main shaft will be revolved by the worm gearing unwinding the lines from the drums; at the same time the rack gears are driven outboard against the davits at relatively the same speed as the lines are being unwound, forcing the davits away from the ship's side. In this part of the operation the boat and davit are as securely held in place as when fully stowed; any movement being opposed by the outboard thrust of the rack and the inboard pull of the lines. When the davits have been forced outboard sufficiently



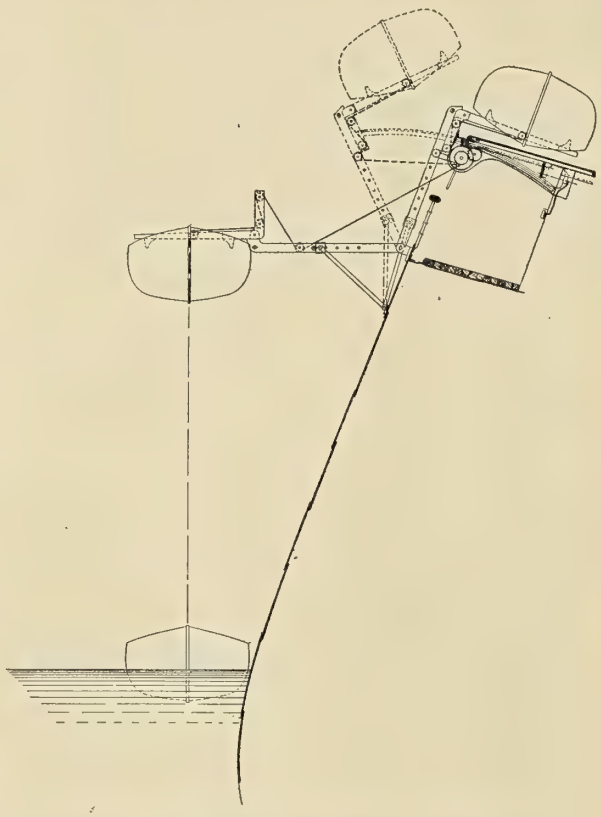
LIFEBOAT AND LAUNCHING DEVICE STOWED ON BOARD.

their weight causes them to continue moving outward and downward until the standing part of the davit comes to rest by reason of the strut guides coming in contact with toggle bolts placed in holes in the standing part. Then the rocking arm turns on its pivot and the boat is turned right side up ready to receive the passengers and crew. Afterward it is lowered clear of the davits into the water, the lines being cast off by any good form of releasing hook desired.

This entire operation is positive regardless of the list of the ship, and by placing the toggle bolts in the proper holes the davits are stopped parallel to the water. The only movement of the davits is outboard or inboard, as the case requires; the davits being permanently guyed in a fore and aft direction. By this system of operation the launching may be controlled by the officer in charge at the boat, or by the officer on the bridge, where there would be a central boat station.

On the after davit is fastened a light metal grating forming a gangway from the ship to the boat when the latter is in the launching position. This gangway is only wide enough to admit one person to pass at a time and is protected on either side by lifelines. One of the main reasons for placing the boat upside down is now evident, *i.e.*, to prevent anyone from getting in before the boat is ready for them. The officer taking his station at the narrow gangway is in a position to see that the boat is properly loaded and manned, and effectually stop any tendency to scrambling and overloading. In no other system has any attempt been made to control a panic-stricken crowd. In this system the boats are always beyond the reach of the crowd, and entirely under the control of the officers.

The boat, when launched, is at a sufficient distance from the ship's side to prevent collision therewith, and to allow the oars to be used the instant the boat touches the water. As both hoisting lines are wound upon drums of the same size, fastened to the same shaft, both ends of the boat will be lowered at the same time. The lines are rove single, without slack at any time, so are not liable to foul. A suitable brake is fitted to the



LAUNCHING LIFEBOAT FROM THE SIDE OF A LISTED SHIP.

shaft for controlling the launching by hand, as it is only necessary to check the speed of the boat while lowering.

As this apparatus does not require any handling of the boats no deck space is required, except what the boats occupy, allowing the boats to be carried nearer together, thus giving increased deck room or allowing more boats to be carried. The weight of the davits proper would be about half that of ordinary davits, the cost being about the same. The motor and gearing, with necessary wiring, would be an additional expense, which may be little or much according to the extent to which the system is elaborated. The use of this apparatus is not restricted to any particular type of vessel, neither is its location restricted.

This system is the invention of Wilbur F. Powers, 318 North Fourth street, Camden, N. J.

The Rockwell Rotary Melting Furnace.

An entirely new type of metal melting furnace has just been brought out which possesses many distinct advantages in economy and ease of operation. One of its principal features is the utilization of the heat of the spent gases of combustion. This is accomplished by means of the two chambers, which are independent but communicate with each other through their necks. One of the chambers is always in the act of melting, the other receiving the spent gases which give up their heat into the fresh charge of metal in this latter chamber. As soon as one melt is poured and the chamber recharged the fire is reversed. In this manner the melting is practically continuous. It is quite reasonable that it should result in a saving of fuel, a saving of time, and a protection of the metal. While the operation as a whole is rapid it will be seen that the metal is always heated up gradually; also that the flame never enters a cold chamber.

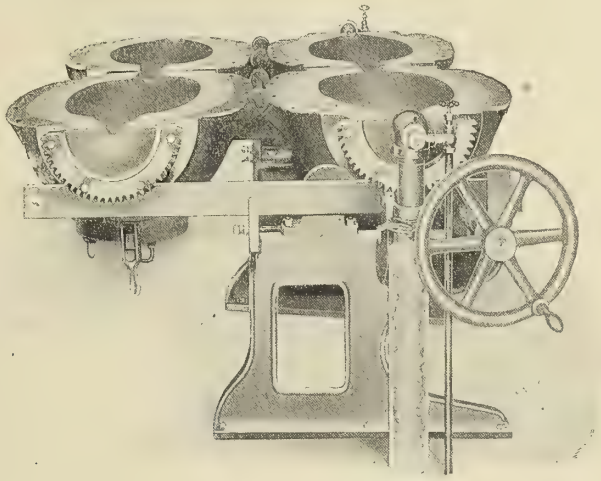
Another feature is the entire absence of crucibles. Nor are any tiles or fire brick used in lining. The lining is an inexpensive material rammed into the furnace shell in bulk and burned hard and refractory in place.

Another feature is the ability to melt two different metals at the same time. While the normal operation is that of melt and reverse, it is also entirely practicable to operate both burners and melt in both chambers at the same time. Where different mixtures are required this would be very convenient. Or the same metal could be melted at the same time in both chambers if an unusually large casting was wanted.

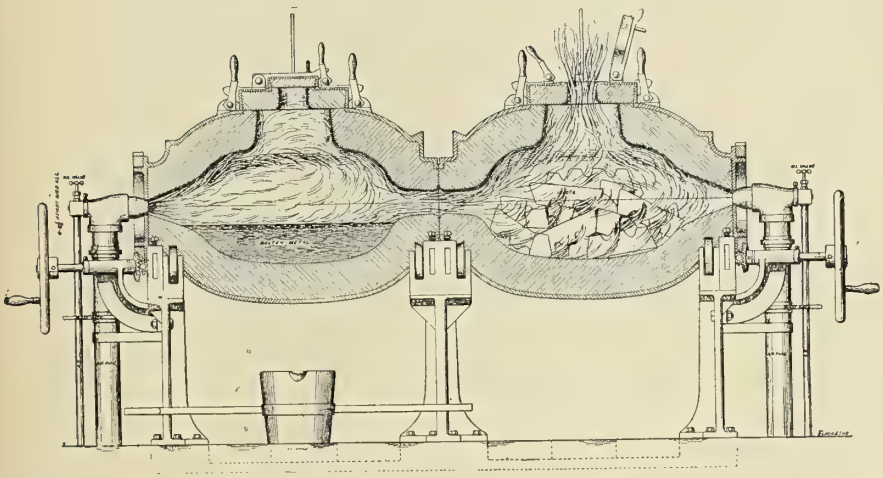
Other features are: large output as to floor space required, general comfort and cleanliness, no complicated parts or expensive repairs. Oil or gas is used as fuel and the air for combustion is supplied from an ordinary fan at about 12 ounces pressure.

The furnace is sold in four standard sizes ranging in capacity from 350 to 3,000 pounds each chamber.

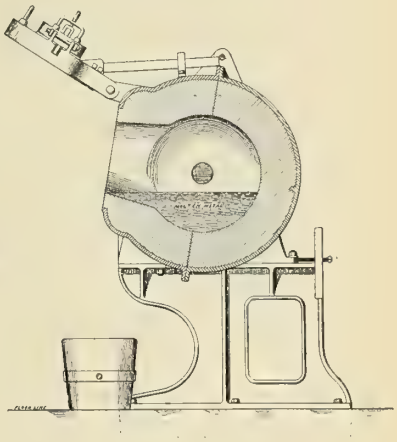
As the name indicates the furnace is manufactured by the Rockwell Engineering Company, 26 Cortlandt street, New York, N. Y.



END VIEW OF FURNACES, OPEN.



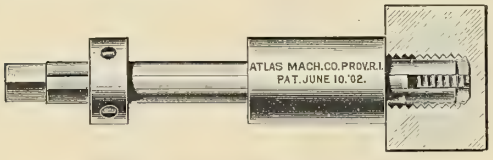
SECTIONAL VIEW OF FURNACES SHOWING METHOD OF MELTING AND HEATING METAL.



POURING THE METAL.

Broken Taps Remover.

The device illustrated in the cut below is adapted to engage and remove pieces of taps which have been broken off in a tapped hole. It consists of a cylindrical holder, whose diameter is substantially equal to the diameter of the tapped hole and which is provided with a square section at one end to receive a wrench. This holder has longitudinal grooves corresponding with the longitudinal grooves in the tap, said grooves being for the purpose of receiving the sliding-tap engaging bars. These bars are fixed at their upper ends in a sliding collar, by which they are moved lengthwise of the cylindrical holder. A loose sleeve is held to slide on the holder, and when the remover is applied to a broken tap the sleeve is slid down close to the work, thus supporting and holding the tap engaging bars in their respective grooves at the point where the strain is applied. This is a simple, strong, quick, and sure device for the removal of pieces of taps broken off in a tapped hole. It engages the broken piece of tap, unscrewing and removing it from the tapped hole without damage to the work. It is always ready for instant use, and saves time and expense.



DEVICE FOR REMOVING BROKEN TAPS.

The outfit consists of a set of six sizes for standard taps, from 1-4 inch to 5-8 inch, and is manufactured by the Atlas Machine Company, Providence, R. I.

Electric Trolley Hoist.

Electric hoists are now in operation in some of the largest manufacturing plants in this country, and are economizing labor and increasing outputs to a wonderful extent.

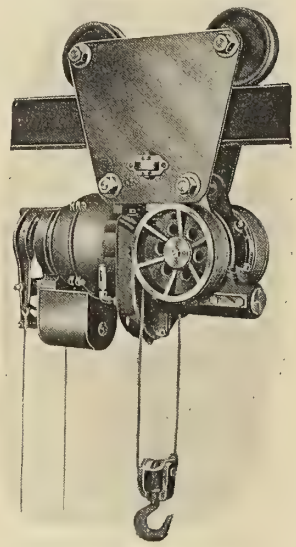
In many machine shops of the usual design, a middle aisle spanned by traveling cranes and side aisles over which galleries are located, the space under the galleries is not fully utilized, because a good power hoist to carry the work to and from the tools has not been obtainable. In most foundries the majority of loads to be lifted weigh less than four tons, and the operation of handling moulds, ladles, etc., calls for fine adjustment and control of the hoisting apparatus. In shipyards and large manufacturing plants where successive operations are conducted in separate buildings, there are many light loads which it is necessary to transfer at high speeds.

These are a few of the conditions which make the type W hoist, built by the Sprague Electric Company, a valuable labor-saving device, as it is specially suited to this class of work.

The cage-controlled electric traveling crane is a highly developed piece of apparatus, and for continuous work where heavy loads are to be lifted and carried considerable distances, it fully meets existing requirements. Extremely delicate movements are, however, difficult or impossible, as the operator in the cage must be signaled from the floor for every lifting or lowering movement until the load safely clears the ground. The load may be a casting weighing a ton or less, which is to be lifted from the floor to a machine tool a few feet away. The entire operation, including bringing the crane to the work, will take considerable time, and during that time other portions of the works are probably waiting for that crane and its operator. A few type W hoists could be used at several points at once, and if controlled from directly beside the load the adjustment can be as delicate as desired.

Air hoists, hand chain blocks, and steam cranes are found in great profusion in foundries, because they are made in small units and can be controlled from near the load.

Hand chain blocks are slow, and air hoists require the installation of an expensive compressor and reservoir



ELECTRIC TROLLEY HOIST.

system, and are limited in travel by the amount of hose it is possible for them to drag along without rupture. The direct-acting, cylinder-type air hoist is limited in height of lift, and if a vertical cylinder is used more headroom is occupied by the cylinder than the available lift. The air-motor hoist is an extravagant power consumer, and the power lost in leakages in the hose and piping of either type, with all hoists shut off, is often as much as would be required to operate an equivalent system of electric hoists.

The electric hoist is claimed to present every advantage of high power per space and weight, efficiency, durability, ease of control, and range of transmission, and nearly all factories are now equipped for electric power. A successful electric hoist, however, must be practically indestructible, because it is handled not by a skilled operator but by the ordinary factory help. It should be weather-proof and of extremely light weight, as it is often necessary to use it outdoors or to install it on runways attached to buildings already erected, and if the weight of the hoist itself is excessive this often becomes difficult.

The hoist herewith described and illustrated was designed with a thorough knowledge of the above-men-

tioned conditions. It consists of three distinct parts: the hoist proper, including the motor and gearing; the controller; the trolley carriage.

The hoist proper consists of a weather-proof Lundell round type series wound motor, the necessary speed reduction being obtained by a spur and a worm gear. The drums are mounted on the worm-wheel shaft, one on either side of the wheel, and when chain hoists are ordered sprocket wheels are substituted for the drums.

The gearing and one motor bearing is enclosed in an oil-tight gear case; this case being bolted to the end of the motor and partly filled with grease or oil. The rotation of the gears automatically oils all wearing parts.

The use of a combined spur and worm gear makes it easy to obtain automatic lubrication without danger of oil running back into the motor, as the shaft of the motor is placed above the oil level, and also allows a high ratio of speed reduction to be obtained in small space and for low weight of gearing.

Only the very highest grade of material enters into the construction of this apparatus. The motor has a steel frame; the worm is steel case hardened and ground, the thrust being taken by hardened steel ball or roller bearings, and the worm wheel is made of a special grade of bronze. All gears are cut, and all parts called upon to bear the strain of the load are designed with a large factor of safety.

The rope-operated controller is mounted on the hoist, hoist carriage, or bridge, travels with the load, and is operated by hanging cords or ropes, thus doing away with the necessity of having a special crane operator. The type S controller used on this hoist consists of a cylindrical reversing switch provided in the larger sizes with magnetic blowout. No resistance is used with this controller, the current being thrown directly on to the armature. All wearing parts are renewable. This is the strongest and most durable controller it is possible to make.

The brake is operated mechanically by a cam attached to the controller shaft. The brake arms are held together by a spring, and with the controller in the off position the brake is set. When the controller arm is pulled down by the operating cord, the cam on the controller shaft engages two studs attached to the brake levers, and separates the brake arms, thus releasing the brake. The action is positive, and the only wearing parts are the brake shoes which are made of wood and easily and quickly renewable. A limit switch is provided which automatically prevents over-hoisting.

The general offices of the Sprague Electric Company are at 527 West 34th street, New York, N. Y.

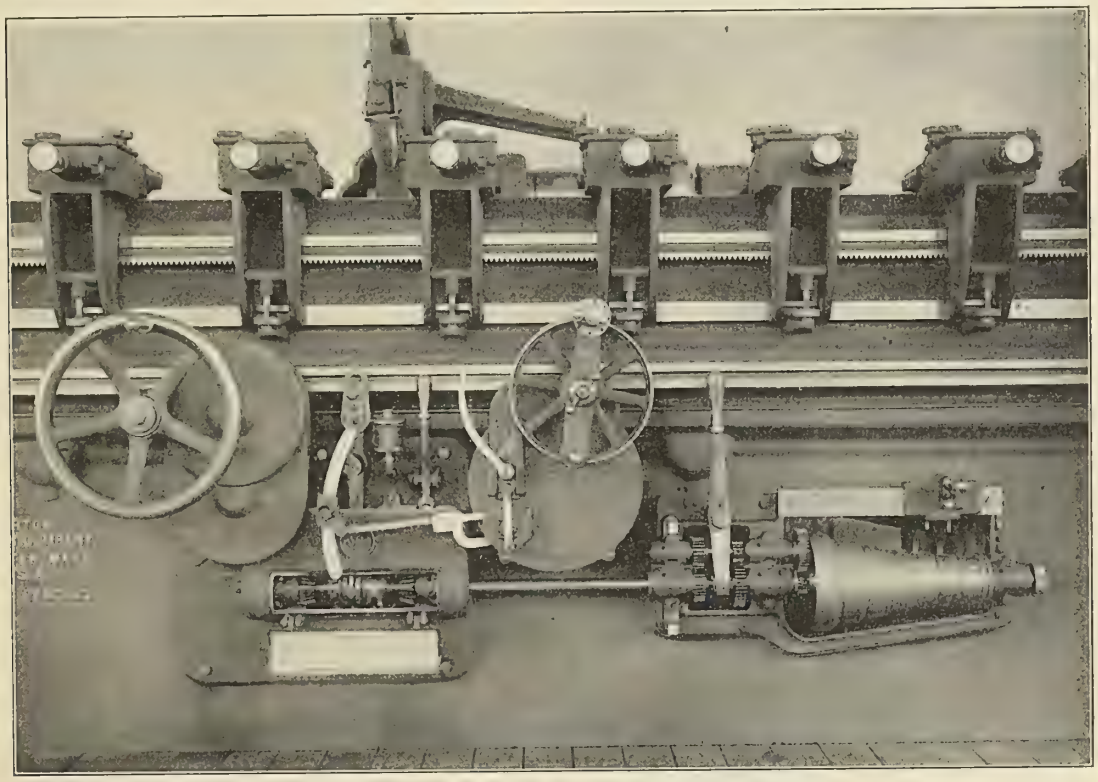


FIG. 1.—ENLARGED VIEW OF FRONT OF NEW CYLINDRICAL GRINDING MACHINE.

New Cylindrical Grinding Machine for Marine Work.

Within the last three years great strides have been made in the art of cylindrical grinding, until it is now wholly practical to finish, by grinding, work up to 14 feet in length and 7,000 pounds in weight. It is also practical to do this grinding at a large saving in cost over the old methods.

Machines such as here shown are now in use in some of the largest shipbuilding plants in Scotland, Ireland, and the United States.

Fig. 2 is a front view of the machine; the length over all is 22 feet; its weight is 22,000 pounds. The distance between centers is 14 feet, and the swing is 18 inches. The grinding wheel is 24 inches diameter, and the machine may be arranged to carry wheels up to 2 inches or to 4 inches thick, according to the class

of work to be done. For ordinary work a 10-horse-power motor is sufficient to drive the machine, while in some special cases motors of 15 horse power are fitted. The machine itself is designed to use a maximum load of 20 horse power.

Fig. 1 is an enlarged view of the mechanism shown at the front near the center of Fig. 2. The cover is removed to show the cone and gearing by which 14 changes of speed are obtained for the traversing work table; these changes can be made instantaneously without stopping work. The reversing clutch and gearing for transmitting the power to the traversing table, also

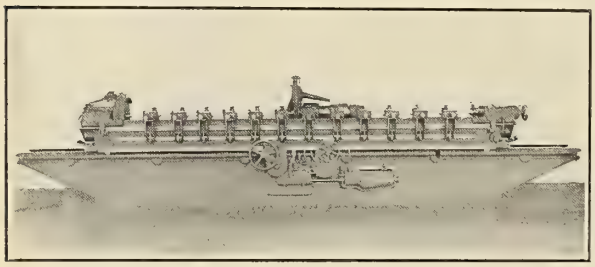


FIG. 2.—22-FOOT CYLINDRICAL GRINDING MACHINE FOR MARINE WORK.

the means for moving the table by hand, are mounted on a very rigid apron, near the left of the enlarged view, with the small cover turned down to show the reversing gears and clutch. The rear view of this apron with gearing swung forward and down will be seen in Fig. 3. This apron also contains the reversing lever

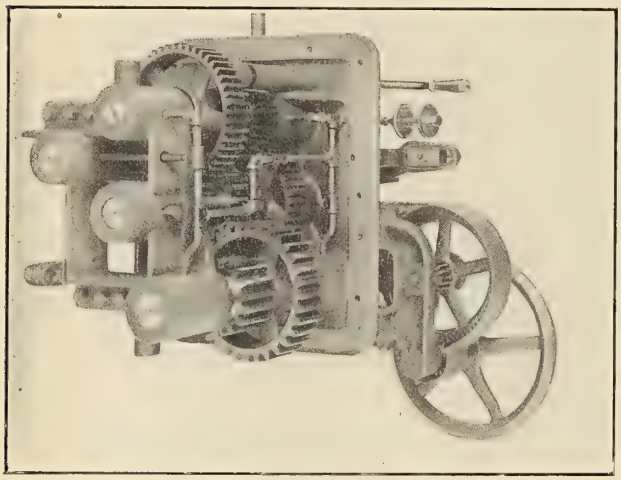


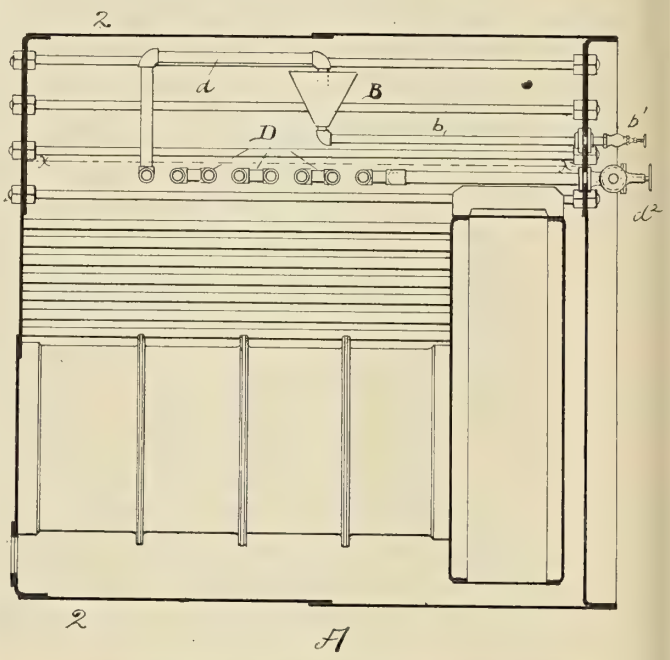
FIG. 3.—REAR VIEW OF APRON.

and lever for starting and stopping the table. The cross-feed mechanism for moving the grinding wheel to the work is shown at the center, between the table speed-cone frame and the apron. The feed is moved automatically or by hand, and has both fast and micrometer motion. The little dial with holes, shown at the top of the index wheel, is used in connection with the small crank and dial pin to obtain reductions in the diameter of work as small as one-quarter thousandth. The arc, shown on the front of the reversing lever, is used to vary the depth of cut of the grinding wheel when using the automatic feed.

The speed of revolution of the work is changed at the head stock by means of the lever and cone. The head and foot stocks are unusually massive and are moved by means of a crank rack and pinion. Some idea of the proportion of these heads may be obtained from the fact that the center holes are 3 inches diameter and the foot-stock spindle is 4 7-8 inches diameter.

The wheel spindle is massive, weighing, with its collars and pulley, 150 pounds; the wheel is guarded by a massive guard covering the wheel and confining the water. The water tank holds over a barrel of water; the pump is of large capacity, delivering 35 to 40 gallons per minute on the work. The form of machine and table is such that the water is cared for, and does not reach the operator or floor.

The machine will grind tapers up to 1 1-4 inch per foot; has massive steel-work drive to withstand hard usage, and is well designed throughout to serve the needs of a heavy marine workship. It is built by the Norton Grinding Company, Worcester, Mass.



SIMPLE FEED-WATER HEATER AND PURIFIER FOR MARINE BOILERS.

Feed-Water Heater and Purifier.

The many advantages resulting from heating the boiler feed water are now recognized, yet in marine work it is not the general practice to install a separate heater other than the hot well. The nearer the temperature of the feed approaches the temperature of the boiler water the less straining the shell is subjected to as a result of unequal temperature, and the longer will be the life of the boiler. Herewith is illustrated a simple device used extensively on the Lakes for not only heating but also for purifying the feed water.

In the Reynolds heater the feed water comes in circulation in the boiler at about the same temperature as the boiler. It, however, possesses the distinctive advantage of acting as a purifier and cleanser as well.

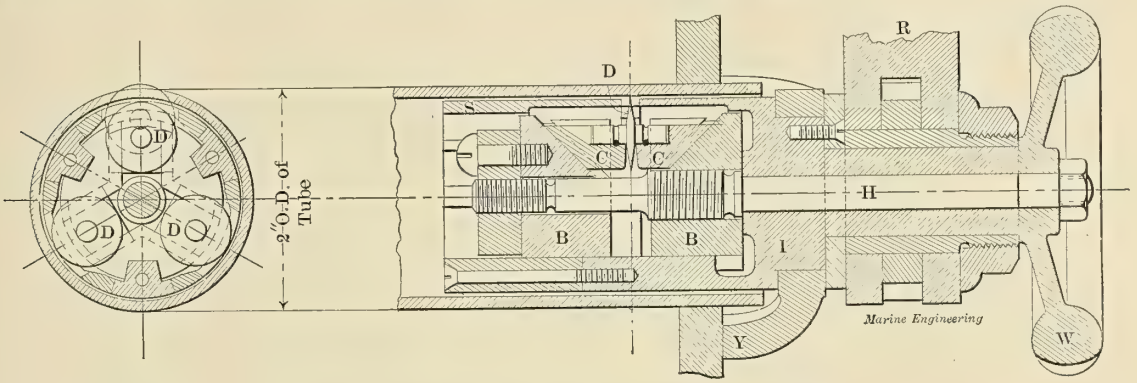
Much of the material held in suspension in the water is precipitated upon heating, and is carried off out of the boiler before it may deposit on the plates or tubes. The working of the heater and purifier will be readily seen by referring to the illustration.

The feed water passes through a blow-off valve d^2 and a check valve placed close to the boiler, into the heating coils *D*, which are placed just below the water level. In these coils the water is heated to practically the temperature of the boiler water, and then it passes through pipe *a* and is delivered into an open-top receiver *B*, supported in the steam space. The discharge pipe *b* extends out through the boiler, and is provided on the outside with a blow-off, b^1.

In operation, the water is forced through the pipe *D*, and heated nearly to the temperature of the boiler water, when most of the impurities are separated. The water discharging into *B* flows over the top, while the impurities settle in the bottom, and may be drawn off from the pipe *b* and blow-off cock. Also, such impurities as may have settled in pipe *D* may be blown out by opening the blow-off cock, d^2. This apparatus is made by Reynolds and Company, Perry-Payne Building, Cleveland, O.

worked by means of the shaft on right and left threads, so as to cause the blocks to approach or recede from each other. The shaft is made to revolve by means of an adjustment hand wheel, *W*. Beveled sliding blocks, *C, C,* which are dovetailed into the cylindrical blocks, carry the knife-edged roller disc cutters, *D, D, D*. A turn of the adjustment hand wheel serves to raise the discs into contact with the tube through slots made in the shell for that purpose, or to lower them as may be required. Cast with the shell is an extension or hub, on which is fitted a yoke, *Y*, as a bearing against the boiler, and also on this hub is fitted a ratchet crank, *R*.

The tool is inserted into the tube until the prongs of the yoke come in contact with the boiler head, and is then held firmly until the disc cutters are brought into contact with the tube, then a turn or two is made with the crank. The entire tool revolves except the yoke, as the crank is turned, care being taken to keep the cutters up against the tube by means of the adjustment hand wheel. Before inserting the tool into the tube a quantity of oil should be poured into the shell through the cutter slots, and it will then feed automatically as required to the cutters.



END AND SECTIONAL VIEWS OF A NEW BOILER-TUBE CUTTER.

New Boiler-Tube Cutter.

The New Century boiler-tube cutter is a tool designed to cut off boiler tubes of any size, when it is desired to take them out of any boiler for any cause, and also to cut off the ends of the tubes at the required length for beading. The tools are made in sizes to suit, and are adapted for use in any variety of boiler. Each tool has three or more specially tempered tool-steel, roller knife-edged disc cutters, mechanically adjusted by means of a hand screw, and operated by a ratchet crank. This tool is so constructed as to automatically oil the tube at the point of contact with the cutting edge of the discs. The cutter does not burr or expand the tube at the point where it is cut off or elsewhere, thus allowing the cutter to be taken out through the tube hole in the boiler head or sheet, and without injury to the boiler—which so often happens when tubes are removed in the ordinary way.

From the cut it will be seen that the working parts of the tool are enclosed in a cylindrical shell, *S*. Through the longitudinal center of this shell passes a shaft, *H*, with right and left threads. Around this shaft are two cylindrical blocks, *B, B,* fitting into the shell, and

Any tube may be cut off in from two to five minutes with this tool, and it is so simple to operate that any man with ordinary intelligence may use it. As a time- and labor-saving invention it will go a great ways in reducing the cost of cutting out old tubes from a boiler. It is the invention of Mr. J. S. Hill, chief engineer of the Interior Department, U. S. Government, and is made by the Kendrich Automatic Damper Regulator Company, Washington, D. C.

Vessels Lost and Condemned during 1903.—A statistical summary compiled by Lloyd's Register for the vessels of 100 tons and upward totally lost, condemned, etc., during the quarter ended June 30, 1903, shows that the total of all countries amounted to 135 of 105,968 gross tons. The greatest of the losers were, of course, Great Britain and her colonies, whose losses numbered 20 vessels of about 30,446 tons. Over half of these were wrecked, and the rest made up of 1 burned, 3 lost in collision, 1 foundered, and 1 missing. The next severest loser was Norway, followed by the United States and Holland.

THE DESIGN OF MARINE MACHINERY.

BY W. F. DURAND.

The Stephenson Link.

The variation of lead with linking up of the gear for both open- and crossed-rod types is thus clearly shown. It yet remains, however, to show the proper curvature of the link in order that such change may be equal at both ends of the stroke.

In Fig. 25 the gear is shown with the engine on the lower or out center, while the valve will be above or to the right of its mean position, and open by the amount of the lead as it may be determined. Suppose now that the eccentric rod QB is disconnected at Q and carried up to P, as shown by the dotted line PB. The link will then occupy the position AB_1, and at mid-gear the valve stem would be moved downward or to the left by a distance KH, thus decreasing the amount of opening by this distance. Again in Fig. 26 the gear is shown with the crank in the top or in center, while the valve will be below or to the left of its mean position, and open by the amount of the lead as it may be determined. Now, suppose again that the rod PB be disconnected at P and carried over to the position shown by QB_1. The link will then occupy the position AB_1, and at mid gear the valve stem will be moved upward or to the right by a distance HK. It is easily seen that with the construction as shown the distances HK in each diagram are the same.

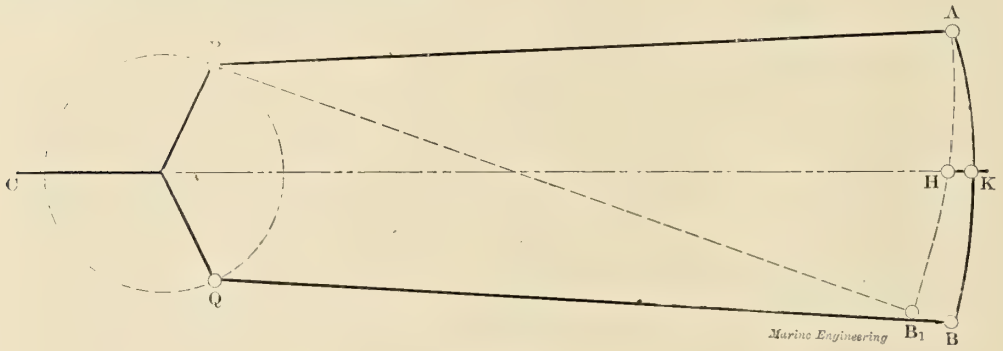


FIG. 25.

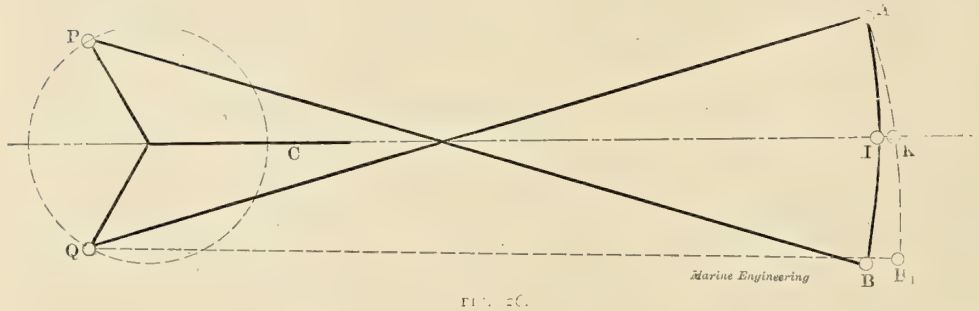


FIG. 26.

Now suppose in Fig. 25 the link is thrown into full gear. This means that the point A will be carried down about P as a center, and will therefore describe the arc of a circle with PA as radius and P as center. Suppose now that the radius of curvature of the link AB_1 is greater than PA; then when thrown into full gear the point A will lie to the right of the H, and the lead between mid and full gear will be cut down by an amount slightly less than HK. At the other end of the stroke, as shown in Fig. 26, suppose likewise the link moved down into full gear. This means that A will move downward, following the arc of a circle about Q as center and with QA as radius. Then if the radius of the link is greater than QA the point A will lie to the right of K, and the lead between mid and full gear will be cut down by an amount slightly greater than HK. Thus, with this value of the link curvature the variation between full and mid gear will be less than HK on the lower end of the stroke, and more than HK on the upper. Similarly it may be seen that if the radius of the link is

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* Continued from January number, page 40.

less than the eccentric rod the variation in the lead will be greater than *HK* on the lower end and less on the upper. It is thus clear than in order to have the variation of the lead the same at each end the radius of curvature of the link must equal the eccentric rod, and that under such condition the point *A* when linked up will coincide with *H* in Fig. 25 and with *K* in Fig. 26, and in each case the change in the lead will be measured by *HK*. In a precisely similar manner the same conclusion may be drawn for the crossed-rod type of gear.

We thus draw the important conclusion that for equal change of lead at each end of the stroke the radius of the link must equal the length of the eccentric rod.

[12] Design of Stephenson Link Gear.

(1) *General Considerations.* The information upon which the design of a Stephenson link is based usually provides the point of *cut-off, port opening* and *lead,* all under normal working conditions. Based on these items the construction of the Bilgram diagram, as explained in [5], may be most conveniently used to determine the simple eccentric which would realize the conditions desired. If, then, two eccentrics, *OA and OB,* Fig. 27, are laid off with throw and angular advance as determined, they would provide the basis of a Stephenson

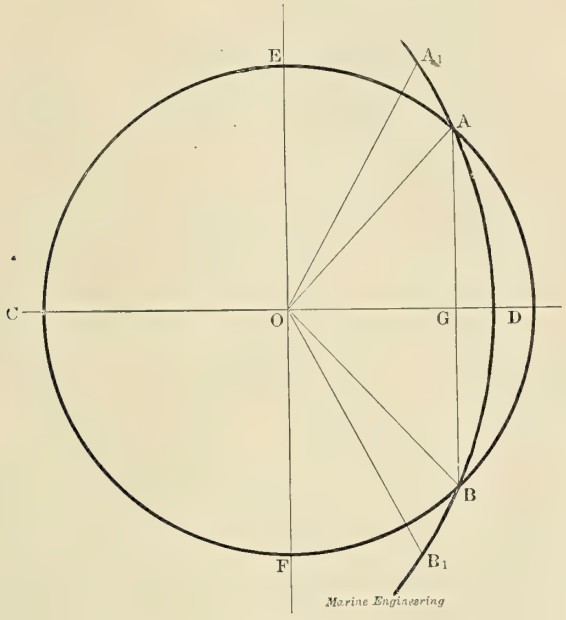


FIG. 27.

link which, when in full gear, would fulfill the specified requirements. The next step will be to determine the path of the end of the virtual eccentric by the method explained in [11]. This requires the determination of the distance *GD* which is measured by the expression $(g \times AG \div 2\ l)$, as explained in [11]. We must therefore proceed to the determination of the lengths of the link and of the eccentric rod. The length of the link should depend primarily on the distance *AB,* Fig. 27, or *PQ,* Fig. 28. Referring to the latter figure it is seen that the link *AB* has its greatest obliquity to the direction in which it must be moved to link up or reverse, when the engine is on or near the half stroke and the crank and eccentrics are located as shown. If this obliquity is excessive it is clear that on attempting to reverse the gear the block at *K* might stick in the link instead of sliding, and some part of the gear might be broken. In order to insure the smooth handling of the link in all positions, therefore, the angle *BRS* between the link and the bridle rod *SR* must not exceed such a value as experience may prove to be suitable for smooth operation under reversal and linking up. Experience thus indicates that the length of the link should be from three to four times the distance *PQ* Fig. 28 or *AB* Fig. 27. Within this range the length of the link may be selected with reasonable assurance of safe and smooth working.

The length of the eccentric rod is determined largely by that of the connecting rod. Care should be taken here to note that the length of the eccentric rod as here considered is its

geometrical length from P to A, Fig. 28, or from the center of the eccentric sheave to the center line of the link. It will be found in a general way that the length of the eccentric rod is not far from that of the connecting rod. The average vertical position of the lower end of both connecting and eccentric rods is the center line of the shaft, while in each case the upper end reaches upward to an average position somewhat below the cylinder and valve-chest casting.

Within a small limit of probable error, therefore, the lengths of the eccentric rod and link may be assumed in advance of the detailed and structural design. We are thus able to determine the distance GD, Fig. 27, and the locus ADB of the end of the virtual eccentric. If now the actual eccentrics to be fitted on the shaft are given a throw of OA, Fig. 27, and an angular advance of EOA, the link in full gear will realize the specified normal conditions. In most cases of actual design, however, it may be considered desirable to be able to realize conditions as to cut-off lying on both sides of the normal. That is, it may be desirable to be able to cut-off at a point slightly later than the normal as well as earlier, and thus in the former case to develop, perhaps for a brief time, an increased power and speed, even if the demand for steam under such conditions is greater than the boilers can normally supply. Such an arrangement is, in short, simply an emergency provision, but it may often be of great importance to provide for such possible increase of power, and thus to consider the normal running condition as belonging to a position of the gear slightly linked up rather than full gear.

In Fig. 27, suppose the curve ADB to be extended slightly at each end, and points A_1 and B_1 to be taken as shown. Then with but slight error we may take $A_1 DB_1$ as the locus of the outer end of the virtual eccentric for a pair of actual eccentrics represented by OA_1 and OB_1. For such a pair of eccentrics OA is a virtual eccentric corresponding to the position

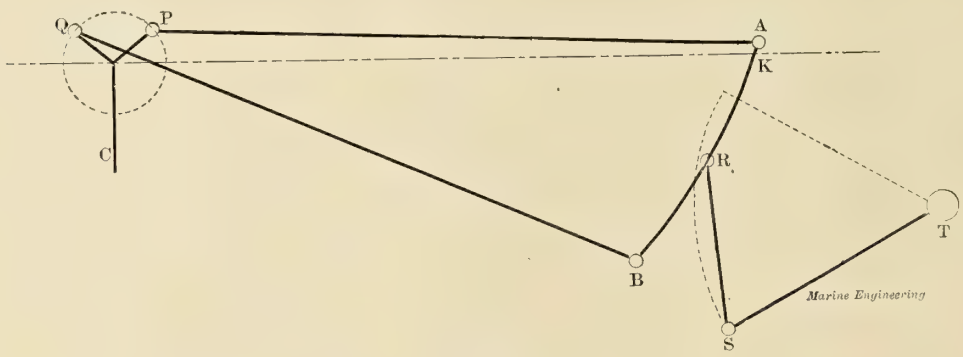


FIG. 28.

of the block linked up from A_1 to A or whatever fraction of the half link $A_1 A$ may bear to $A_1 D$. If, therefore, we fit a pair of actual eccentrics, as represented by OA_1 and OB_1, we shall be able to realize the normal schedule of operation by linking up to A, while at full gear the cut-off will be later and port opening greater, as determined by the eccentric OA_1. We shall thus provide for the emergency development of increased power at full gear with the block at A_1, for normal power with the block at A and for reduced power with the block at points between A and D. The relative length of $A_1 A$ to $A_1 D$ is wholly a matter of judgment. It may be usually taken at 1-8 to 1-6 or even greater if desired.

The actual eccentrics OA_1 and OB_1, as thus fitted, are therefore different from those first determined by the Bilgram diagram OA and OB, in having, as shown, a greater throw and decreased angular advance.

There still remain for determination the following items of the gear:

Location of rock-shaft center: T, Fig. 28.

Length of rock-shaft arm: TS, Fig. 28.

Length of bridle rod: RS, Fig. 28.

Location of reverse or saddle pin: R, Fig. 28.

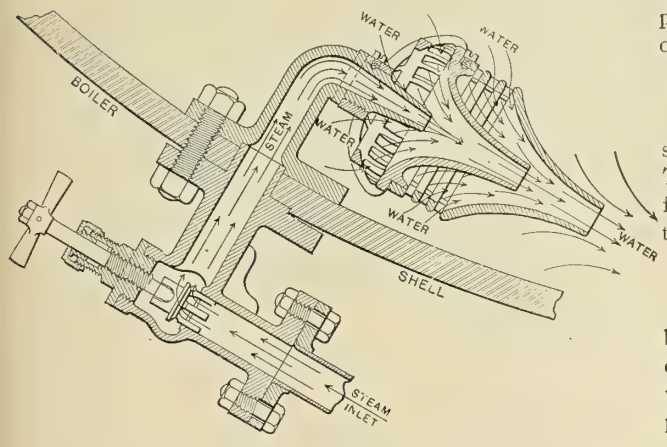
It is readily seen that these various items are not independent, and they must therefore be considered one with reference to another. It is also found that, in particular, the locations of R and of T exercise a noticeable influence on certain features of the operation of the gear, especially as regards the block slip, and the possibility of adjusting or equalizing the points of cut-off on the two strokes.

These various effects are of sufficient importance to warrant consideration in some detail.

QUERIES AND ANSWERS.

Q. 193.—Please give information and sketch of a hydrokineter and where it is attached to boiler, and explain its use. W.

A.—In answer to this we reproduce the cut and description of the hydrokineter in PRACTICAL MARINE ENGINEERING.



This is an appliance used to force the circulation of the water in the boiler, more especially when raising steam. It consists, as shown in cut, of a steam jet and series of nozzles with frame perforated at the back for the entrance of water. The steam is furnished from another boiler, and by its inducing action a current of water is set up and driven along, as shown by the arrows. This arrangement is placed near the bottom of the boiler and thus serves to drive out the cold water which tends to collect there, and which is only slowly heated by the operation of natural circulation.

Q. 194.—The engine of my stern-wheel boat is a compound, 10 and 20 inches by 48 inches stroke; cut-off, 3-4 stroke; steam, 150 pounds; wheel, 14 feet diameter, 27 turns per minute; the receiver is a 5-inch pipe, 14 feet long; and the engine is worked with a condenser at 20 inches vacuum. What results could I reasonably expect by increasing the pressure to 250 pounds by using water-tube boiler? E. L.

A.—First let us calculate what the mean effective pressure of your engine is reduced to the low-pressure cylinder. There are 5.33 expansions of steam in your cylinder from the point of cut-off to the full volume of the low-pressure. This is found by figuring the volume in cubic inches of the low-pressure and the volume of the high-pressure up to the point of cut-off, and dividing one by the other. Or,

$$\frac{314.16 \times 48}{78.54 \times 3\text{-}4 \times 48} = 5.33.$$

The absolute steam pressure of the boiler is 150 + 14.7 = 164.7. This at the engine is reduced to about 161 pounds, we will say.

Now from the formula, the theoretical mean effective pressure will equal the absolute pressure times a factor which is found in all books containing steam tables, which for this case = .5. From this product the back pressure must be subtracted, and in this case of 20 inches vacuum the back pressure is about 5 pounds.

Thus (161 × .5) − 5 = 85.5 pounds theoretical M.E.P.

To allow for clearances, condensation, etc., the theoretical pressure must be multiplied by another factor called the card factor, to reduce it to the actual M.E.P. For a single-expansion engine this will be about .75, so multiplying the above by .75 we have:

$$85.5 \times .75 = 84.1 \text{ M.E.P.}$$

If you increase your initial steam pressure by 100 pounds, and cut steam off at the same point, the above operation is changed.

$$(261 \times .5) - 5 \times .75 = 94.1 \text{ pounds M.E.P.}$$

It is probable, however, that with the increased pressure you would bring the cut-off, say, to one-half stroke. Then there would be 8 expansions and the constant found in the book corresponding to this is .385. Then the mean effective pressure would be:

$$(261 \times .385) - 5 \times .75 = 69.7 \text{ pounds M.E.P.}$$

It is probable that if you should not change the cut-off, by reason of the increased steam pressure you could drive the engine at the neighborhood of forty turns, while with the cut-off at one-half stroke the wheel would probably be driven thirty revolutions per minute.

Another great advantage of higher steam pressure is that with the increased number of expansions in your cylinder you reduce the steam per revolution.

Graphite Separator.

Editor MARINE ENGINEERING:

In your December issue, one of your readers states his need of a graphite separator. As I have done a great deal of experimenting with graphite, I am in a position to help him out of his difficulty. The accompanying sketch shows a graphite separator made by me several years ago, and as it worked very successfully, I take pleasure in offering this design to your readers. Of course, for use on board ship it is too bulky, but as some of my experiments in this line have proven that graphite in the exhaust steam is very good for surface condenser tubes as well as the heating surface of a boiler, I would advise the marine engineers not to worry about separating it.

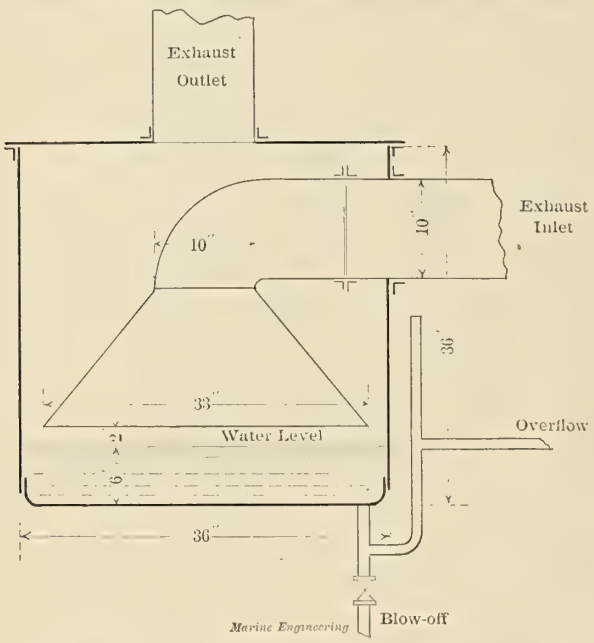
The construction of the separator is very simple. The main part is a sheet-iron tank, into one side of which the exhaust pipe passes; inside of the tank the pipe is turned downward, and ends in a large cone. This cone contains four brass wire screens, of No. 20 wire, the upper one with 8 meshes to the inch, and the others with 10. These screens serve to break up the current of steam. The bottom of the tank is covered with water to the depth indicated, and is provided with overflow and blow-off.

The engine to which this arrangement was attached was a 20x42-inch single-cylinder Corliss engine, driving a small ice machine. The exhaust of this engine was 8 inches diameter, but a short distance from the engine I increased it to 10 inches of spiral riveted pipe, of which all the rest to and from the separator was made; this was done in order to reduce the velocity of the exhaust steam. The cover is held down by bolts, and can be removed for cleaning; for this purpose the exhaust pipe is flanged close to the bend, so the cone can be removed and the wire screens cleaned, which was

found to be necessary about once in four years. The operation will be clear by examining the cut.

I also wish to state that, when using graphite, it should not be mixed with oil, but should be poured dry into an ordinary tallow cup, and a little pure water poured on top of it. If the engineer wishes to use both graphite and oil, it is advisable to use them in separate cups.

For gas engine cylinder lubrication I have used quite extensively powdered soapstone as a lubricant, and found it to give most excellent results. The successes obtained with this lubricant in cylinder and valve chests,



when using superheated steam in steam engines, was also quite unexpected. The hotter the cylinder walls were the better the soapstone served as a lubricant. It is most important that the soapstone used should be free from grit.

I will be very glad to communicate with any of the readers of Marine Engineering on the subject of graphite lubrication, and graphite separators as well as soapstone lubrication, if they care to address me through these columns. W. E. Raabe.

PERSONALS.

B. G. Londen has been appointed mechanical engineer of the New York Shipbuilding Company.

N. S. Braden, formerly of the Westinghouse Electric and Manufacturing Company's district office at Cleveland, Ohio, has been appointed sales manager of the new Canadian Westinghouse Company, Limited. He succeeds the late Thomas C. Frenyear, who died on December 10 of last year, with headquarters at Hamilton, Ontario.

Stephen M. Tasker, who has been connected with the Cramp Shipbuilding Company for twelve years, has been appointed chief draftsman of the Bureau of Steam Engineering at the Norfolk Navy Yard.

Fred. A. Peacock, of the engineering department of the Bath Iron Works, has accepted a position with the Mallory Line in the engine department of the new twin-screw coasting steamer *San Jacinto,* recently built by Roach's Ship Yard.

W. E. Joynes has severed his connection with the hull department of the Bath Iron Works to accept a similar position with Fore River Ship and Engine Company.

William B. Newton, formerly an engine draftsman at Bath Iron Works, is now with Fore River Ship and Engine Company.

R. L. Newman has removed his office to 66 Broad street, New York, N. Y., and become associated with Weir Merryweather. They will continue their business of naval architecture and consulting engineering.

Progress of Naval Vessels.

The Bureau of Construction and Repair, Navy Department, reports under date of January 13, 1904, the following degree of completion of vessels building for the United States Navy:

			Per Cent. Degree of Completion.	
BATTLESHIPS.			Dec. 1	Jan. 1.
Missouri	18 knots.	Newport News Co	99.1	99.9
Ohio	18 "	Union Iron Works	83.5	84.5
Virginia	19 "	Newport News Co.	50.4	52.5
Nebraska	19 "	Moran Brothers Co.	33	35
Georgia	19 "	Bath Iron Works	40	42.5
New Jersey	19 "	Fore River S. and E. Co	48.9	49.43
Rhode Island	19 "	Fore River S. and E. Co.	48.8	50.61
Connecticut	18 "	Navy Yard, New York, N. Y.	24.7	26.7
Louisiana	18 "	Newport News Co.	31	34.5
Vermont	18 "	Fore River S. and E. Co.	1	2.7
Kansas	18 "	New York Shipbuilding Co.	2	2.6
Minnesota	18 "	Newport News Co	8	12
ARMORED CRUISERS.				
Pennsylvania	22 knots.	William Cramp and Sons	63.2	64.9
West Virginia	22 "	Newport News Co.	67.3	70.5
California	22 "	Union Iron Works	48	51
Colorado	22 "	William Cramp and Sons	67.4	69
Maryland	22 "	Newport News Co.	63.1	65.4
South Dakota	22 "	Union Iron Works	44 5	47
Tennessee	22 "	William Cramp and Sons	12 9	15.1
Washington	22 "	New York S. B. Co.	9.7	12
PROTECTED CRUISERS.				
Denver	17 knots.	Neafie and Levy	98	98
Des Moines	17 "	Fore River S. and E. Co.	96	97
Chattanooga	17 "	Lewis Nixon	72	72
Galveston	17 "	Wm. R. Trigg Co	69	70
Tacoma	17 "	Union Iron Works	96.5	99
St. Louis	22 "	Neafie and Levy	34.8	36.2
Milwaukee	22 "	Union Iron Works	38.5	41
Charleston	22 "	Newport News Co.	55.2	56.9
GUNBOATS.				
Dubuque	12 knots.	Gas Engine and Power Co.	15	20
Paducah	12 "	Gas Engine and Power Co.	13	16
TRAINING SHIPS.				
Cumberland	Sails	Navy Yard, Boston	7	12
Intrepid	"	Navy Yard, Mare Island	0	5
TRAINING BRIG.				
Boxer	Sails	Navy Yard, Portsmouth	3	6
TORPEDO BOATS.				
Stringham	30 knots.	Harlan and Hollingsworth	93	93
Goldsborough	30 "	Wolff and Zwicker	99	99
Blakely	26 "	George Lawley and Son	99	99
Nicholson	26 "	Lewis Nixon	99	99
O'Brien	26 "	Lewis Nixon	98	98
Tingey	26 "	Columbian Iron Works	100	100
STEEL TUGS.				
Pentucket	12 knots.	Navy Yard, Boston	96	100
Sotoyomo	12 "	Navy Yard, Mare Island	95	98

TECHNICAL PUBLICATIONS.

The Practical Physics of the Modern Steam Boiler. By Frederick J. Rowan. Size 6 by 9 inches. Pp. 638, with 314 figures in the text, and introduction by Dr. R. H. Thurston. D. Van Nostrand Company, New York. Price $7.50.

The title of this comprehensive work admirably suggests the point of view and mode of treatment which the author has chosen for his discussion of this all-important feature of our modern material civilization. He has treated the subject primarily with reference to the physical laws which relate to the steam boiler and their practical application to the various problems which the design, construction, operation, and especially the improvement of the modern steam boiler present.

The work, as a whole, is divided into nine chapters, of which the first is introductory and has especial reference to the lines which the development of the steam boiler has followed, and the particular points which a good boiler should possess.

Chapter ii. then proceeds with the fundamental elements of boiler design, particularly with reference to the problem of strength under the various complex stresses to which the boiler as a structure is subjected. In chapter iii. the general topic of combustion is considered with reference to the chemical operations involved and the heat liberated, and with reference to the various practical methods for controlling, perfecting, and forcing the combustion employed in actual steam boilers. Air heaters, mechanical stoking, methods for the use of dust fuel, gas, and liquid fuel, receive full notice, and the chapter closes with a reference to the experiments in 1899 of the Navy Department on the Great Lakes with stokers for marine service. In chapter iv. the transmission of heat through the plates forming the heating surface is considered. This is taken up primarily with reference to the established physical laws, and a large amount of information is given derived from numerous experiments bearing on this topic, which are also discussed with reference to various equations and formulæ which have been proposed for expressing the relation between the transmission of heat and the attendant conditions. In chapter v. the circulation of the water is dealt with in the same general manner. The fundamental physical laws are first presented, and their application to the circulation of water in a boiler is then discussed. The subject of this chapter is of special importance in view of the recent extended discussions regarding the circulation of the water in boilers of the water-tube type, and in this chapter will be found a comprehensive summary of the more important of these discussions, and with reference to the attendant experimental results when such were carried out in connection with the study of the problem referred to. In chapter vi. the subject of the strength of materials entering into the boiler is again taken up, with especial reference to the influence of heat on the tenacity and ductility of such materials. Many experimental results are given and the general topic is discussed with reference to its effect on the problems of steam boiler design. In chapter vii. the important topic of corrosion and incrustation is dealt with in the same thorough manner. The chemical and physical laws bearing on the question are discussed, a historical résumé of the development of the difficulty in marine practice is given, and various methods for the control and prevention of these harmful actions are described and discussed. In chapter viii. the subject of boiler design is taken up chiefly from the historical and descriptive points of view. The various types and styles of boilers are briefly described and considerable attention is given to the vast multiplicity of examples furnished by the modern water-tube type. The term design, in the heading to this chapter, relates rather to construction than to the adaptation of size and proportion to the realization of a stated schedule of conditions. In chapter ix. the subject of boiler tests and results is taken up. Reference is made to the more prominent of the tests which have become historical, and a large amount of valuable information is given in connection with the results of more recent tests under modern conditions.

The author in his preface states clearly that he has not cared to follow the well-beaten paths of former works, and that he is not so much concerned with actual or existing practice as with the directions along which improvement and development should proceed. He points out that this brings a certain change in the point of view, and that in consequence the point in regard to fuel, for example, is not so much the existing ratio of fuel consumed to grate area, but rather what is the largest quantity which can be burned in a given time, with or without a grate, with the minimum labor and maximum efficiency. So with many other features, and throughout the work the author has given less attention to existing practice than might perhaps have been expected in a work on this subject. It is perhaps this point of view which has led him to dispense with any adequate discussion of the subject of design. The subject matter of chapter ix. is in effect the relation between the boiler as a structure and the boiler as a steam generator, and it would naturally serve as the direct foundation for a discussion of boiler design so far as the determination of characteristics and proportion is concerned. This important part of the subject, however, seems to be for the most part lacking. The engineer or student who is seeking guidance in the design of the boiler as a steam generator will, it is true, find an abundance of fundamental facts from which such design may be developed, but he will not find collected together a clear and comprehensive discussion of the principles of design, and will receive small aid in this particular part of his study of the boiler. It cannot be too clearly understood that in all engineering design note must be taken of two distinct divisions of the work: the design, so far as characteristics and proportions are concerned, and the design as a structure. The first fixes the leading features of the design in terms of fundamental characteristics and essential ratios and proportions; the second has for its aim the realization of the preceding ideal or abstraction in a definite and safe engineering structure. The principles underlying the latter field of design will be found discussed in the present work, though some might perhaps wish for a closer contact with actual practical construction as determined by the rules of the leading registration societies and governmental boards. This, however, is purposely omitted from the author's scope and must be sought elsewhere as needed. The

first or fundamental field of design, however, is scarcely noticed, and constitutes a real shortage in what might seem to be fairly within the proper scope of the book.

Having disposed of this word of criticism as to the policy of the author it is a pleasure to refer to the excellent work which the book shows throughout in the field as covered by his design. The high reputation of the author as a writer and as an engineer lead us to expect a judicious selection of the subject matter to be actually presented, an accurate and logical presentation of such matter in detail, and a clear and illuminating discussion of the subject throughout. In this we are not disappointed and the book in general meets our just expectations in these respects.

In one or two instances a good illustration is furnished of the rapidity with which facts grow old and change or lose significance. Reference is made at the close of chapter iii. to what are termed "recent experiments" made by the United States Navy Department on certain steamers on the Great Lakes fitted with automatic stokers. From the terms used in referring to the results the casual reader might suppose them recent, relative to 1903 instead of 1900, when this part of the book was written, and that the problem of the firing of coal in marine boilers was likely to be immediately and profoundly influenced by these experiments—conclusions which the actual facts have not justified.

The book as a whole is a most valuable and welcome addition to the literature on the subject, and the author may be properly congratulated on having furnished a solid addition to the discussions available to the progressive engineer on the leading topics relating to the improvement of the modern steam boiler. The aim of the author seems to have been, in a word, the comprehensive presentation and discussion of the physical laws on which the operation of the steam boiler depends, with facts drawn from experience and illustrations from practice, all with a view to the further improvement of the boiler as a steam generator and as an engineering structure. In such purpose he has been successful to a marked degree, and the work may be recommended to all who are especially concerned with this aspect of the problem presented by the modern steam boiler.

Machine Design, Part I., Fastenings. By William Ledyard Cathcart. Size 6 by 9 1-2 inches. Pp. 291, with 119 figures and diagrams in the text. New York: D. Van Nostrand Company. Price $3.00.

The purpose of the author in preparing this work has been to present in compact form for the use of the student and designer the best modern American data and practice in this branch of the broad field of machine design. Mechanisms and engineering constructions of all kinds are, with few exceptions, made up of various members, and these parts must be fastened together. The general subject of fastenings is therefore one of great importance for both the designing and constructing engineer.

In the present work the subject is treated both theoretically and from the standpoint of practice, thus giving a very full and satisfactory discussion of the general ground covered. The field is divided into five chapters dealing with shrinkage and pressure joints, screw fastenings, theory of riveted joints, practice and results with riveted joints, keyed and pin joints.

Under pressure and shrinkage joints the treatment is especially full and the discussion of formulæ and of practice should be especially acceptable to engineers who may be called on to deal, on a large scale, with fastenings of this character. Of especial note in this chapter are the formulæ developed by Professor Alger, U.S.N., for the shrinkage stresses developed in the assembling of modern hooped ordnance, with illustrations of the details as shown in the design and construction of a modern high-powered gun.

Under the head of screw fastenings a full discussion is given of the theory of the screw, including friction and the consequent stresses developed in both the bolt and nut under various complex conditions. A large number of tables are also given presenting in compact form a large amount of data for the immediate use of the designer and engineer. Of especial note here is the excellent treatment of locks and fastenings to prevent the loosening up of screwed joints under jarring and periodic stress.

The general subject of riveted joints, from its great importance, naturally receives large attention. The theory is necessarily imperfect, due to our ignorance of the distribution of stress in both the plate and rivet. On the usually accepted basis, however, a very full and clear exposition is given, and the various proportions for riveted joints of all practicable types are deduced in accordance therewith. A large amount of tabular matter is also given, together with the results of a large number of tests on joints of various types.

The subject of keyed and pin joints is taken up with the same thoroughness of detail both in theory and practice, and this section gives a most satisfactory presentation of the general subject of fastenings of this type.

Taken as a whole this book constitutes a most useful contribution to the literature of machine design. In perhaps no other work relating to the modern engineering practice is the general subject of fastenings treated with the degree of thoroughness and balance, both from the viewpoints of theory and practice, which is here found. The volume should form a most acceptable addition to the working library of every designing and constructing engineer.

Sexton's Boiler-Makers' Pocket Book. By Maurice John Sexton. Size 5 by 3 inches. Pp. 319, with diagrams. New York: Spon and Chamberlain. Price $2.00.

This is the sixth edition of a work on boiler construction which has long been favorably known throughout the boiler-making and shipbuilding trades. The book was originally prepared as a working pocket book for the daily use of the author, and to avoid the need of making calculations at the moment wanted, and to remove the chance of mistake under such circumstances. It contains the usual tables of areas and circumferences, proportions of riveted joints, points on laying out and building boilers of the usual types, together with special tables and data useful in many problems with which the boiler maker is called on to deal.

The book contains also chapters on steel masts and yards for ships, and on shipbuilding. The author would

have done better to stop with the boiler section. The chapter on shipbuilding is too short and too heterogeneous to be of any great value to the shipbuilder.

Within the field of boiler construction, however, this work contains a large amount of information, and in convenient form for the every-day needs of the boiler maker or sheet-metal worker.

Mechanical World Pocket Diary and Year Book for 1904. Size 6 by 4 inches. Pp. 278, including diary. Price 6d. Emmett and Company, Ltd., Manchester, England.

This, the seventeenth annual issue of the diary, has some special features, which are: sections on the valve diagram, completely rewritten and amplified; a table giving the calculated results for moduli of many sections; tables for weight of copper bars, others on the stresses of bolts, pipe fittings, and further formulæ. In general, the work has been revised and brought up to date.

The Increase in the Size of Mercantile Steamers, with Reference to their Economic Return. By C. B. Schultz. Size 7 1-2 by 10 inches. Pp. 111, with many diagrams and tables. Berlin: M. Driesner. Price $2.50.

This is a publication in German of a thesis for the degree of Doctor of Engineering, presented before the faculty of the Technical High School at Berlin, the most famous of the German engineering schools.

The book as published represents the results of a special investigation into the relation between the size of ship and her various characteristics and features, especially in regard to their weight and their influence on the capacity and economic performance of the ship. The investigation was directed along two main lines, one having reference to a high-speed, fine-lined type similar to the *Deutschland,* and the other having reference to a full-formed cargo steamer of moderate or low speed, of which the *Palatia* was taken as the example. These types were also carried out in various ways according as special weight is to be given to the carrying of cargo without reference to other considerations, to the cargo with reference to the cost of the ship, or with reference to the cost of the machinery and the expense of operation.

In the detail of the work a vast number of formulæ have been developed and a series of tables and graphical charts are given, all having reference to the weight of the various elements entering into the ship, and with regard to the various special conditions to be fulfilled. The question of the bending moment, the necessary strength for the conditions to be fulfilled, the indicated horse power, and the various relations of these items to the question of the economic returns are likewise discussed in the same thorough manner.

The work throughout is of the exhaustive, painstaking character so typical of German research, and will prove a valuable mine of suggestive method and information to those interested in this branch of the subject and who may be able to read the German language, in which the book is alone at present accessible.

Practical Lessons in Electricity. Size 7 by 10 inches. Pp. 226, with numerous cuts. American School of Correspondence, Armour Institute, Chicago.

According to the preface this volume contains four of the forty-five text books in the electrical engineering course of the American School of Correspondence at the Armour Institute of Technology. The purpose is to give the public an opportunity to judge of the standard and scope of the instruction offered, and while only fragmentary as regards the entire course offered, it is hoped that in itself the volume may not be without value to the expert electrician as well as to the amateur.

The volume contains four pamphlets treating on the elements of electricity, on the electric current, by L. H. Sager; electric wiring, by H. C. Cushing, Jr.; and on storage batteries, by F. B. Crocker. The treatment of the subject matter is necessarily simple and practical in order that it may be adapted to the needs of the correspondence method of instruction. A large amount of practical information is, however, contained in these chapters, and if they form fair samples of the whole number the course in electrical engineering would seem to be eminently practical and admirably adapted to the class of students held especially in view by this method of instruction. The absence of any index and the separate paging of the chapters make the present volume of less value than it might have been were it published with more direct reference to use in the present form.

Record of American and Foreign Shipping. 1,300 pages. 8 by 9 1-2 inches. Price $5.00. American Bureau of Shipping, 66 Beaver street, New York, N. Y.

The volume for 1904, which is the thirty-sixth annual issue of this valuable register, is now being delivered to subscribers. The Record contains full reports and particulars of about 17,000 vessels, ranging from the infrequent ketch to the full-powered transatlantic liner, and flying the flag of every nation, alphabetically arranged with much detail as to build, ownership, and condition. This information forms the bulk of the annual volume, but it also contains rules for the construction and classification of all classes of vessels, with illustrations and tables, all of utmost technical and practical value; revised rules for the construction of machinery and boilers, electric installation, and refrigerating apparatus on shipboard.

The volume contains names of vessels which have been changed; list of compound names arranged alphabetically by last word of name for ready reference; list of addresses of prominent shipbuilders, dry-docks, and marine railways of the United States; list of owners of vessels, all of much value to the shipping interests. The work is approved and endorsed by the important boards of underwriters of the United States and is accepted by the merchants and underwriters throughout the world as a standard classification of shipping.

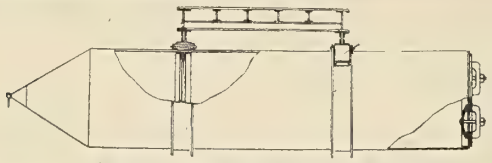
Supplements to the volume, issued semi-monthly, keep subscribers informed of new vessels constructed during the year; with reports of repairs to old vessels and other useful information.

Practical Engineer Pocket Book for 1904. Size 5 1-2 by 3 1-2 inches. Pp. 576, with 64 pages for diary on ruled sectional paper. Gilt edges, flexible morocco. Price 1s. 6d. Technical Publishing Company, Manchester, England.

This forms the sixteenth annual edition of this pocket book, which has been revised and brought up to date. Alterations and additions have been made, among which is a description of the Sterling water-tube boiler, the Daimler motor, and notes on patents and patent law. It is a convenient edition for the engineer.

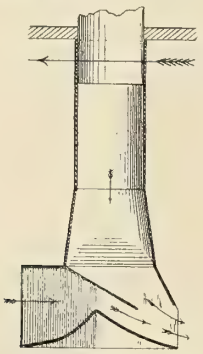
SELECTED MARINE PATENTS.

745,192. FLOATING BRIDGE. HERMANN KAMPMANN, KREIS ESSEN, GERMANY.



Claim.—1. A floating bridge supported by closed pontoons which are arranged turnable around their longitudinal axis so that each pontoon can be turned round to allow an inspection of all parts and particularly those which had been under water and to permit further an easy exchange of pontoons—all without interruption in the use of the bridge. Five claims.

744,950. VENTILATOR FOR SHIPS. CHARLES A. WITHERS, AUGUSTA, GA.



Claim.—1. In a ventilator for ships and the like, a casing having a passage therethrough, communicating with the space to be ventilated, the inlet opening to said passage being directed toward the wind and having an inwardly-inclined wall, an outwardly-inclined wall or extension leading from the rear end of said inwardly-inclined wall, and a deflecting blade lying substantially parallel to the latter wall or extension and located at the point of intersection of the passage through said casing with the passage leading to the space to be ventilated, the said blade forming a contracted portion in the passage through said casing into which said inlet opening leads, and terminating at its rear end a short distance from the rear end of said outwardly-inclined wall or extension. Two claims.

745,469. APPARATUS FOR SUBMARINE WORK. CHARLES WILLIAMSON, NEWPORT NEWS, VA. Twenty-one claims.

745,732. PROPULSION MECHANISM FOR VESSELS. HENRY H. LITTLE, PHILADELPHIA, PA. Four claims.

745,853. PROPELLER. HENRY C. INGRAHAM, NEW HAVEN, CONN.

Claim.—1. A propeller-blade a cross-section of which at any and all points between the hub and outer end represents a segment of a cycloidal curve and the curved portions being formed from generating circles whose diameters increase from the hub outwardly. Three claims.

745,871. SCREW PROPELLER. JAMES B. MACDUFF, BROOKLYN, N. Y.

Claim.—1. A propeller, consisting of a hood or casing, a hub and blades connecting said hub and hood or casing, said hood or casing flaring outwardly from its rear to its forward end, and said hub tapering from its rear to its forward end, at which point it is of less diameter than at its rear end. Three claims.

745,910. PROPELLING VESSELS. CHARLES F. SAUTTER, BROOKLYN, N. Y.

2. A vessel having a driving shaft and driving gear therefor, a way and a swinging-deck section, and tracks on the way and at the under face of the deck-section, so that as the latter is swung open or outward the track-sections at the movable deck are exposed to form a continuation of the track sections on the way, said movable deck section having prongs or catches for securing a hold and said tracks registering with the gear for running a vehicle to and from engagement with the gear.

3. A vessel comprising a rudder, a driving shaft and driving gear, and a track adapted to receive a vehicle and hold the driving wheels thereof to the gear, said track having pivoted sections to enable the steering wheels of the vehicle to swing when connected to the rudder.

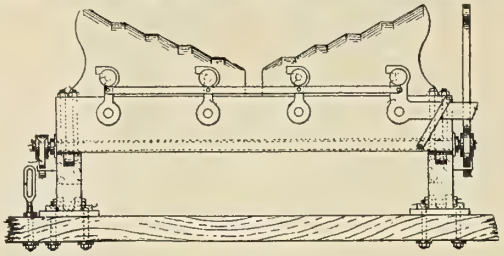
4. A vessel comprising a driving or propelling shaft, a gear for operating the shaft, and a way or tracks registering with the gear to permit of an automobile or like vehicle to be run to and from engagement with the gear. Four claims.

746,007. PROPELLER. EWALD BRUNCKER, COLOGNE, GERMANY.

Claim.—1. A propeller having a dished propeller-blade, thinnest at the middle portion and gradually increasing in thickness to the sides and ends, the entrance and exit edges being beveled. Six claims.

746,169. RELEASING DEVICE FOR SHIPS' BOATS. WILLIAM H. ROTHWELL, LONDON, ENGLAND.

Claim.—1. In combination in a releasing device for boats, chocks for holding the boat, a beam supporting the chocks, supports for said beam and a lever for collapsing said supports.

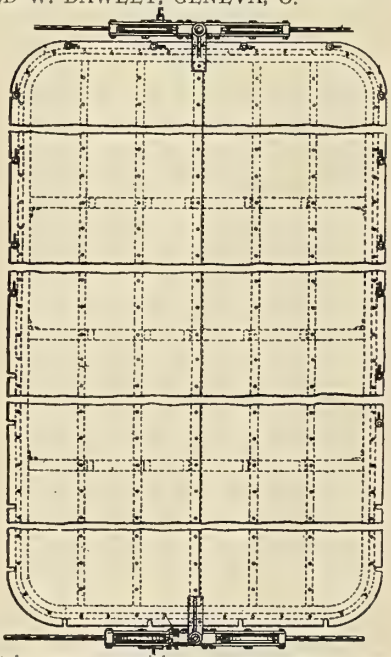


2. In combination in a releasing device for boats, chocks for the boat, a beam supporting the chocks, collapsible supports for the beam comprising a number of plates hinged together, a lever, a shaft connected thereto, and means on the lever and shaft for collapsing said support. Four claims.

746,606. SUBMARINE BOAT. DANIEL F. TOOMEY, GUILFORD, CONN.

Claim.—1. In a boat of the character described, the combination with the hull, of vertical guides extending from the deck to the bottom and forming internal braces for the hull, a tubular conning tower fitted to slide vertically between said guides, and means for raising and lowering said tower. Five claims.

746,929. HATCH COVER FOR MARINE VESSELS. WINFIELD W. DAWLEY, GENEVA, O.



2. A hatch cover, comprising a cover proper or top, longitudinal and transverse braces under the same and arranged to give the cover a crown or rounding form for the purpose specified, and means engaging the edges of the cover to raise the same.

4. The combination of a hatch cover, a truck therefor, and means for raising the cover on and lowering the cover from the truck.

5. The combination of a hatch cover, a truck at each side thereof, and means for connecting the trucks with the cover.

6. The combination of a hatch cover, a truck therefor, and means connecting the cover with the truck and including an elevating device.

7. The combination of a hatch cover, a truck therefor, and means connecting the cover with the truck and includingg a jackscrew to permit raising and lowering the cover.

8. The combination of a hatch cover, a truck therefor, a gear in connection with one of the wheels of the truck, a second gear meshed with the first gear, and means for facilitating the operation of the second gear.

9. The combination of a hatch cover, a truck at each side thereof, a jackscrew mounted on each truck, and brackets attached to the cover and having the jackscrews respectively operating therein.

10. A hatch cover, comprising a body portion or top, and longitudinal and transverse ribs or braces fastened to the under side thereof. Ten claims.

746,995. FLOATING DISCHARGE PIPE FOR HYDRAULIC DREDGES AND MEANS FOR CONNECTING SAME TO DREDGES. ARTHUR W. ROBINSON, MONTREAL, CANADA. Fourteen claims.

746,996. APPARATUS FOR HYDRAULIC DREDGING AND DISTRIBUTING THE DREDGED MATERIAL. ARTHUR W. ROBINSON, MONTREAL, CANADA. Seven claims.